Volume 6 July, 1927 Number 7

JOURNAL

OF THE

AMERICAN WELDING SOCIETY

Published Monthly by the American Welding Society
33 West Thirty-ninth Street, New York

American Welding Society

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JOURNAL

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33 West Thirty-ninth Street, New York

Subscription $10.00 per year to United States. $11.00 to Canada. Libraries $5.00
Back numbers, per copy: Members, $0.50; Non members, $1.00.

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AMERICAN WELDING SOCIETY
ESTABLISHED 1919
JOURNAL

Volume 6 JULY, 1927 Number 7

TENTATIVE PROGRAM
of
1927 FALL MEETING
AMERICAN WELDING SOCIETY
to be held in
DETROIT

SEPTEMBER 19, 20, 21, 22 and 23, 1927

HEADQUARTERS: BOOK-CADILLAC HOTEL

MONDAY, SEPTEMBER 19

Morning

Registration—Registration facilities will be provided at the Exposition Headquarters in Convention Hall all day Monday, commencing at 9:00 a. m. for the men, and at the Book-Cadillac Hotel for the ladies. A registration fee of $1.00 per person will be charged. It is planned to have all the entertainment features "free" to members with the exception of the annual dinner.

Noon

Luncheon for ladies at Book-Cadillac Hotel.

Afternoon

Automobile Ride for ladies.

Meeting of Board of Directors, A. W. S.—2:00 p. m., Book-Cadillac Hotel.

Evening

Meeting of Pressure Vessel Research Committee—7:30 p. m., Book-Cadillac Hotel.

TUESDAY, SEPTEMBER 20

Morning

Technical Session—10:00 a. m., Book-Cadillac Hotel.

1. Airplane Welding by J. B. Johnson, Chief Material Branch, War Department, Air Corps, McCook Field.
2. Welding on the Long Distance Aircraft by Curtiss Aeroplane Corporation.

Afternoon

Technical Session—2:00 p. m., Book-Cadillac Hotel.

1. Report of San Francisco Section's Investigations on "Study of Welds Subjected to High Temperatures."

TUESDAY AFTERNOON (*Continued*)

2. Heat Treatment by the Oxy-Acetylene Flame by E. E. Thum, Associate Editor, Iron Age.

3. A Metallurgical Study of Welds by G. R. Brophy, Research Laboratory, General Electric Company.

Moving Picture Theatre Party for Ladies—2:00 p. m.

Evening

Theatre Party. Details will be announced later.

WEDNESDAY, SEPTEMBER 21

Morning

Technical Session—10:00 a. m., Book-Cadillac Hotel.

1. Car Welding by Victor Willoughby, General Mechanical Engineer, American Car and Foundry Company.

2. Automobile Welding by W. C. Happ, Chief Engineer, Dept. Methods and Standards, Studebaker Corporation.

It is planned to have a number of automobile concerns discuss this paper.

Noon

Luncheon and Musicale for Ladies at the Detroit Yacht Club.

Afternoon

Inspection Tours—2:00 p. m.

Arrangements have been made for inspection tours to the River Rouge Plant of the Ford Motor Company and to the plant of the Fisher Body Corporation.

Evening

Meeting of Structural Steel Welding Research Committee—7:30 p. m., Book-Cadillac Hotel.

Carnival Dance with American Socoiety for Steel Treating, Hotel Statler.

THURSDAY, SEPTEMBER 22

Morning

Technical Session—10:00 a. m., Book-Cadillac Hotel.

1. Production Welding of Water Heater by H. J. Grow, Air Reduction Sales Company.

2. Welding in the Plant of the Combustion Engineering Corporation by C. S. Reed, Vice-President and General Manager.

Afternoon

Technical Session—2:00 p. m., Book-Cadillac Hotel.

1. Welding of Structural Steel by Joseph Matte, Jr., of Albert Kahn, Inc.

2. Welding in the Design of Steel Plate Work by L. J. Sforzini, Engineering and Maintenance Department, Eastman Kodak Company.

Ladies' Shopping Tour—2:00 p. m.

THURSDAY (*Continued*)

Evening

Annual Fall Dinner Dance of the American Welding Society, 6:30 p. m., Book-Cadillac Hotel.

EXPOSITION

Welding and Cutting Exposition Largest Ever Held

The Welding and Cutting Exposition held under the auspices of the American Welding Society and in cooperation with the National Steel and Machine Tool Exposition in Detroit the week of September 19 will be the largest exhibit of its kind ever held. A special section of Convention Hall of over 10,000 square feet has been set aside for the welding exhibit. Consequently all of the exhibits will be grouped together and the thousands in attendance will have the opportunity to observe the latest and best equipment and developments in this line.

SAMUEL WYLIE MILLER MEDAL

Through the generosity of Mr. S. W. Miller, a past-president of the American Welding Society and Consulting Engineer of the Union Carbide & Carbon Company, there has been established by the Society a gold medal to be known as the "Samuel Wylie Miller Medal." This medal is to be awarded annually during the lifetime of Mr. Miller for meritorious achievement in certain branches of the welding art—the award to be made under the conditions prescribed by a board of trustees.

Under the terms of the gift, the medal is to be administered by a self-perpetuating board of trustees consisting of E. H. Ewertz, C. A. McCune and F. M. Farmer, chairman. The sum of $150.00 is to be paid to the American Welding Society on or before the first day of January of each year for the support of the medal.

Suitable rules and regulations covering the award of the medal are now being prepared by the Board of Trustees and will be published in the Year Book of the American Welding Society.

TORONTO STEEL AND POWER SHOW

A Power Show will be held at the University of Toronto Arena, Toronto, Ontario, on Aug. 31, Sept. 1 and 2. A number of welding exhibits will be held at this show. Among the papers that will be presented will be one by Mr. J. F. Lincoln of the Lincoln Electric Company on "The Redesign of Present Riveted and Cast Structures to the Use of Arc Welding and Structural Steel," a paper by Mr. S. W. Miller of the Union Carbide & Carbon Research Laboratories on "Economies of Oxy-Acetylene Welding," and a paper by Mr. H. H. Moss of the Linde Air Products Co. on "Oxy-Acetylene Welding."

OBITUARY

Mr. P. William Kromer, forty-seven years old, district sales manager of the Air Reduction Sales Company, Buffalo, died recently. Mr. Kromer was a charter member of the American Welding Society and active in its affairs. He was a member of many organizations and clubs and was identified with the oxy-acetylene industry for nearly twenty years. Mr. Kromer is survived by his widow and one son.

SOCIETY PRESIDENT HONORED

President F. M. Farmer of the American Welding Society has recently been awarded the prize of the American Institute of Electrical Engineers for the best paper presented during the year and the prize for the best regional paper. The subject of the paper dealt with "Insulated High Tension Cable."

DETROIT MEETING

(Editorial Released by American Society for Steel Treating)

Over 25,000 manufacturing executives and scientists of the metal-working and metal treating industries from every state in the Union, Canada and many foreign countries, will assemble in Detroit the week of Sept. 19 to participate in the numerous technical sessions to be held and to attend the National Steel and Machine Tool Exposition.

It is seldom that four national technical societies interested in the metal industry, convene simultaneously in the same city, yet the five days of the week of Sept. 19 will witness such an unparalleled event at Detroit. The technical sessions of the American Society for Steel Treating will include the manufacture, use and treatment of iron and steel; while the technical sessions of the Institute of Metals will include the manufacture, use and treatment of non-ferrous materials.

The Production Meeting of the Society of Automotive Engineers will embrace papers covering the latest scientific methods of production in all departments of manufacture including the use of machinery, machine tools, inspection and treatment of materials. In addition, the American Welding Society will have a comprehensive program on the latest developments and uses of welding equipment and material and show the great advances made in the welding industry.

More than 300 firms from all of the metal-working centers of the United States and some foreign countries will use 85,000 square feet to demonstrate their equipment under actual operating conditions and it will be the largest factory equipment exposition ever held in America. The exposition combined with the national meetings of four technical societies, providing facilities for securing technical information from both the theoretical and practical standpoints, will draw to Detroit one of the largest and most representative gatherings of the metal industry ever assembled.

LONG-DISTANCE GAS TRANSMISSION

In a recent bulletin gotten out by the A. D. Little, Inc., the possibility of transmission of gas through long-distance high pressure lines, is featured. The following is a quotation from this bulletin:

"Long-distance transmission in pipe lines has long been applied successfully to natural gas, as well as to petroleum and water. Two gas pipe lines from West Virginia to Ohio are 300 miles long, of 20-inch reducing to 16-inch welded steel pipe. The newest natural gas line, now awaiting completion of contracts, is to extend from the Texas Panhandle to Kansas City, Missouri. This line will be 450 miles in length, of 20-inch welded steel pipe, and will transmit the gas at a maximum pressure of 450 pounds per square inch. Seven gas pumping stations, using gas engines for power, will be located along this line. The daily throughput will be 100 million cubic feet. Experiments have shown the leakage losses to be very small and the whole project to be feasible."

RESEARCH

There is quoted below an editorial appearing in the June, 1927, issue of *Engineering News-Record*. This editorial shows the trend of thought of executives of some of our larger industries. Fortunately for the welding industry, research has always played an important part in the activities of the American Welding Society and in many of the prominent companies connected with welding.

Research to the Fore

Research by industry may look forward to a great gain through the organization of the Steel Corporation's new research department on the high scientific basis assured for it by the selection of Dr. John Johnston as head. The corporation's announcement of its plans, some months ago, to enter into research was an agreeable surprise, and the pleasure is now heightened by the promise that this work will be fundamental and scientific. Such work is indispensable if the practices of technologic craftsmanship and traditional method are to be transformed into controlled and definitely known process. Many people have come to believe in recent years that the most formidable element of the great steel industry did not recognize this, but was interested only in production and tonnage, in doing today on a larger scale what it did yesterday. And well informed voices sounded warning from time to time that despite all advantages of

ore, fuel and markets, this was not a sound way to assure the future. Nevertheless, the industry continued to prosper, and to amass steadily greater wealth on the old basis. But meanwhile every other field of technology had turned to research as a vital adjunct to business—soap making, textile manufacture and power production. Introduction of industrial research into production has in fact been the great evolutionary process in the field of the material arts during the past two decades. It has come to be a truism that commercial leadership cannot persist unless it has research as an inseparable companion. Now that an art which is among the oldest and noblest of all joins the ranks of the others, the fabric of industrial research will be strengthened even more. The growth and fruitfulness of industrial research will gain from the stimulus.

LINDBERGH PLANE OF CONVENTIONAL CONSTRUCTION

Extracts from Clipping from May 26, 1927 Issue of IRON AGE

The remarkable mechanical performance which made Capt. Charles A. Lindbergh's non-stop trans-Atlantic flight possible appears even more unusual in the light of the fact that the monoplane, "Spirit of St. Louis," was not an especially designed plane. Although built with a wing-span of 46 ft., from 2 to 4 ft. more than the span of the regular production ships of Ryan Air Lines, Inc., San Diego, Cal., it followed rather closely the normal specifications of the company's commercial planes.

Fuselage Made of Alloy Steel

The framework of the fuselage was made of chromemolybdenum steel seamless tubing, with joints welded. It was covered with regulation airplane fabric.

WELDED STEEL PURIFIER

(Communication to the Editor)

The Semet-Solvay Engineering Corporation of New York has begun work on a Welded Steel Purifier and a Multiple Washer for the Michigan Avenue station of the Atlantic City Gas Company. The purifier will be 48 feet wide, 120 feet long and 13 feet deep. It is understood to be the largest one yet built entirely by welding. It will have three compartments and ground space has been reserved for adding a fourth when needed. The apparatus will be capable of handling upward of 450,000 cubic feet of water gas an hour.

A number of features in design make the installation unique. The equipment, first of all, is being built for high speed operation. A test pressure of 2½ pounds per square inch is specified for the purifier. The gantry crane, which will operate the doors, will carry an oxide elevator and screw conveyor and will be able to handle 2000 cubic feet of oxide an hour. The purifier will be built on an elevated structure with dumping doors placed on the bottom for emptying the used oxide. The supporting framework, like the remainder of the equipment will be of welded steel construction.

A 24-inch welded steel manifold 5/16 inch thick, will connect the present piping with the new unit and will supply gas to any of the three compartments or all of them in series, or will reverse the direction of gas flow through the layers of oxide.

The foundation design calls for a structure sufficiently strong to withstand a 100-mile wind. Whether this is required because of the danger of tornadoes or to resist the blasts of convention oratory, so abundant at Atlantic City, has not been made clear. Steere-built welded equipment has already been assailed by the elements. A welded steel purifier went through the Miami hurricane and a washer cooler stood up through a tornado in Havana, although surrounding buildings were leveled.

The multiple washer, capable of removing impurities from 10,000,000 cubic feet of gas a day will be built in two complete units, each 9 x 10 feet, of double deck design and operating in parallel. This will enable the company to have equipment of the needed capacity with a minimum of ground space used. Like the remainder of the apparatus, there will be no rivets in the construction of this multiple washer, it being completely welded.

A. FISCHER.

Remember the Dates
Fall Meeting
American Welding Society
Detroit, Sept. 19-23.

HONOR LIST

W. Spraragen	1	Class A
	6	Class B
	3	Class C
J. H. Edwards	2	Class B
D. G. MacInnes	2	Class B
	1	Class C
	2	Class D
Hugh Chambers	1	Class B
W. R. Hulbert	1	Class B
C. Bradshaw	1	Class B
J. J. Crowe	1	Class B
C. D. Miller	1	Class B
A. M. Candy	1	Class B
O. J. Bornemann	1	Class B
F. H. Williams	2	Class C
	1	Class D
E. J. Cipperly	2	Class C
Charles M. Rusk	2	Class C
	3	Class D
J. C. Cumberland	1	Class C
E. Backman	1	Class C
H. L. Whittemore	1	Class C
R. D. Thomas	1	Class C
A. G. Bissell	1	Class C
H. Doud	1	Class C
R. K. Randall	1	Class C
H. S. Card	1	Class C
E. B. Ferree	2	Class D
J. H. Thornton	1	Class D
W. M. Griffith	1	Class D
E. A. Smith	1	Class D
H. E. Hollis	1	Class D

NEW MEMBERS

For Months of March, April, May and June

BOSTON

Class C

John E. Swift, Welder, Worcester Gas Light Company, (res.) 801 Millbury St., Worcester, Mass.

Osmon A. Tilton, Electrical Engr., General Electric Company, (res.) 15 Winthrop Ave., Marblehead, Mass.

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H. E. Horwood, Salesman, Taylor & Arnold Engrg. Co., Ltd., (res.) 37 Shannon St., Montreal, P. Q.

D. G. MacInnes, Quebec Editor, Canadian Machinery, MacLean Publishing Company, 1070 Bleury St., Montreal, P. Q.

J. G. McCarty, Branch Manager, Metal & Thermit Corporation, 15 Emily Street, Toronto, Ontario.

R. E. Smythies, Vice-President, Lincoln Electric Co. of Canada, Ltd., 65 Bellewoods St., Toronto 3, Ontario.

Fred H. Williams, Ass't Test Engr., Canadian National Railways, (res.) 51 Rutland Ave., Mount Royal, P. Q.

Class C

Harry N. Lead, Chief Electrician and Aircraft Metal Park Dept., Canadian Vickers, 529 St. Clements, Viauville, Montreal.

A. D. McCall, Salesman, Drummond McCall & Company, Ltd., Montreal, Canada.

Alexander Peden, Chief Draughtsman, Dominion Bridge Company, (res.) 161 Strathearn Ave., Montreal West.

Class D

E. E. S. Cheffins, Aircraft Welder, Canadian Vickers, Ltd., (res.) 1447 Theodore Ave., Maisonneuve, Montreal.

Harry Dower, Acetylene Welder, Canadian National Railways, (res.) 190 Queen St., Stratford, Ont., Canada.

Wm. Jones, Welder, Canadian National Railways, (res.) 32 Lefebore St., Cartieville, Montreal, Que.

CHICAGO

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James W. Haygood, Service Supervisor, Linde Air Products Company, 1945 Peoples Gas Bldg., Chicago, Ill.

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Class B

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Grover A. Hughes, Electrical Engr., Truscon Steel Company, Youngstown, Ohio.

Class C

M. H. Turner, Branch Manager, Purox Company, 1255 Marquette St., Cleveland, Ohio.

Class D

H. F. Wooden, Welder and Assembler, David Lupton Sons Company, 3515 Fairmount Blvd., Cleveland Heights, Ohio.

DETROIT

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Guy F. Allen, Structural Engineer, Detroit Edison Company, (res.) 220 California Royal Oak, Detroit, Mich.

G. H. McNab, Welding, (res.) 79 Garfield Avenue, Detroit, Mich.

M. L. Miller, Foreman, Detroit Edison Company, (res.) 3769 Canton Avenue, Detroit, Mich.

Class C

E. P. Jeffery, General Superintendent, American Blower Company, 6004 Russell St., Detroit, Mich.

Carroll L. Wilson, Engrg. Division, Westinghouse Elec. & Mfg. Company, 5757 Trumbull Ave., Detroit, Mich.

Class D

Robt. Drummond, Mechanic and Welder, Brunner Mond Canada, Ltd., (res.) Amherstburg P. O.

Arthur Thomas, Acetylene Welder, Detroit Street Railways, (res.) 4218 Fifteenth St., Detroit, Mich.

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H. P. Etter, Los Angeles Manager, Air Reduction Sales Company, Box U, Huntington Park, Los Angeles, Cal.

Class C

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F. E. Van Cleave, Salesman, Robert M. Hartwell, Inc., 353 East Second St., Los Angeles, Cal.

John E. Wilkes, Electric Welder, O. S. L. R. R., (res.) 548 W. Carson St., Pocatello, Idaho.

NEW YORK

Class A

H. J. Kerr, Engineer, Babcock & Wilcox Company, 85 Liberty St., New York City.

Class C

C. W. Davis, R. D. Thomas & Company, 125 Church St., New York City.

T. E. DePew, Eastern Manager, The Welding Engineer, 222 American Circle Bldg., New York City.

J. M. Keir, Chemical Engineer, Union Carbide & Carbon Research Labs., Thompson Ave. and Manley St., Long Island City.

Francis E. Kelley, Designer, Safety Car Company, (res.) 53 Gorham Ave., New Haven, Conn.

Class D

Wm. Kraig, Welder, K. & L. Welding Works, (res.) 240 Wilson Ave., Brooklyn, N. Y.

B. L. Whaley, Proprietor, Oxy-Electro Co., 184 Adams St., Brooklyn, N. Y.

NORTHERN NEW YORK

Class C

LeRoy Beers, Equipment Engineer, General Electric Company, Schenectady, N. Y.

Robt. T. Gillette, Works Manager's Staff, General Electric Company, Bldg. 44, Room 207, Schenectady, N. Y.

T. R. Lawson, Head of Dept. Civil Engrg., Rensselaer Polytech Institute, (res.) Troy, N. Y.

Class D

R. C. Willey, Electric Welder, General Electric Company, (res.) 927 Stanley St., Schenectady, N. Y.

WESTERN NEW YORK

Class B

R. L. Kimber, Manager Indus. Dept., Westinghouse Elec. & Mfg. Company, 814 Ellicott Square, Buffalo, N. Y.

Class C

E. R. Lasher, Electric Welder, Struthers-Wells Co., (res.) 116 Elm St., Warren, Pa.

PHILADELPHIA

Class B

J. E. Hires, Consulting Engineer, (res.) 107 Linwood Avenue, Ardmore, Pa.

Class C

V. S. Grundy, President, Ornamental Iron Works, Inc., Trenton, N. J.

George L. Leiby, Welding Supervisor, Spicer Manufacturing Company, (mailing address, P. O. Box 313), Pottstown, Pa.

John C. Reed, Supt. Electric Dept., Bethlehem Steel Company, (res.) 410 Pine St., Steelton, Pa.

Ezra A. Smith, Welder, Giant Portland Cement Company, (res.) 710½ North Twelfth St., Allentown, Pa.

Class D

G. F. Buzzard, Electric Welder, Heine Boiler Company, Phoenixville, Pa., Route No. 3.

H. E. Hersh, Gas and Electric Welder, Bethlehem Fdy. & Machine Company, (res.) 147 No. 7th St., Allentown, Pa.

E. Puchaty, Electric and Acetylene Welder, Bethlehem Steel Company, (res.) 120 So. Fifth Ave., Coatesville, Pa.

Edward Renner, Welder, Giant Portland Cement Company, Box 114, Egypt, Pa.

R. A. Zentner, Welder (electric), Bethlehem Fdy. & Machine Company, Route No. 2, Allentown, Pa.

PITTSBURGH

Class B

R. C. Crouch, Mechanical Engineer, Riter-Conley Mfg. Company, Oliver Building, Pittsburgh, Pa.

E. L. Quinn, Jr., Supervisor of Welding, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

A. R. Ellis, General Manager, Pittsburgh Testing Laboratory, P. O. Box 1115, Pittsburgh, Pa.

L. D. Reilly, Manager, Ambridge Plant, American Bridge Company, Ambridge, Pa.

Marshall Williams, Ass't General Operating Manager, American Bridge Company, Frick Bldg., Pittsburgh, Pa.

Class D

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SOCIETY

Class B

J. L. Christie, Metallurgist, Bridgeport Brass Company, Bridgeport, Conn.

Class C

Patrick Fay, Managing Director, South of Ireland Elec. Arc Welding Co., Ltd., (res.) 7 St. Barnabas Gardens, West Road, Dublin, Ireland.

L. M. Hamlet, St. Joseph Structural Steel Company, 8th and Atchison Street, St. Joseph, Mo.

Peter K. Peeff, Mechanical Engineer, Ragas, Moscow.

Class D

R. D. Collins, Welder, Freeport Sulphur Co., P. O. Box 246, Freeport, Tex.

Hollis Nichols, Welder, Freeport Sulphur Company, Freeport, Tex.

Walter Sobol, Welder, Box 25, Marshall, Mo., Nicholas-Beazley Airplane Company.

SECTION ACTIVITIES

Western New York

The Western New York Section reports an interesting visit by Mr. James Hollis, a member of the Section, to Palmir, Republic of Colombia, where he is now engaged on a large welding job. Mr. Hollis states that the climate is excellent, although it gets hot in the middle of the day, but not much hotter than Buffalo during the summer. The soil is very rich and the republic raises sugarcane, coffee, rice, cotton and tobacco. Wonderful opportunities are presented to ambitious men with small capital.

Mr. Hollis is working on a steel pipe line for conduction water about six miles long. The pipe is made from sheet steel sent from the United States in 5-foot lengths, which is then formed into pipe of 12-inch and 14-inch diameter. Six sections of 5 feet each are then arc welded in the shop and carried to the field, where they are welded together. He is also engaged on building welded tanks for a large sugar mill. These tanks are 18 ft. x 8 ft. x 6 ft. with two partitions on the inside.

EMPLOYMENT SERVICE BULLETIN

POSITIONS VACANT

V-39. A practical welding engineer—a man familiar with the electrical and acetylene fields and capable of demonstrating the use of wire for welding purposes. The man desired must have a knowledge of sales work and be capable of closing sales in the field; handle sales correspondence regarding welding applications and assist other salesmen in general welding sales problems.

V-40. Wanted, a man who knows from personal experience and practice, all there is to know about oxy-acetylene welding and cutting and its application to industry. Would prefer the same man have a thorough understanding of electric welding as well. He should have the ability to teach, should have an effective personality, sufficient tact and diplomacy so that he can properly represent the company to the customers, and serve both them and us to the best advantage.

V-41. Salesman wanted. Must have following qualifications: Be able to "take off" structural steel and light iron work for estimating purposes; be familiar with the application of electric welding to fabrication of above classes of work; be able to "sell" this method of fabrication to others; be sufficiently "sold" himself to the value of this method of fabrication to be willing to tackle a new and undeveloped territory in New England on a straight commission basis.

Research Activities of the Air Reduction Sales Company*

JOHN J. CROWE†

The oxy-acetylene industry while young as compared with many of the other industries with which it must compete has made wonderful strides in the short time of its existence. Following Le Chatelier's discovery of the principle of the oxy-acetylene flame in 1895, the first welding torch was developed by Fouche and Picard (1901) and this development was followed closely by the cutting torch. The first torches were more or less crude in construction and performance as judged by present standards. They required high acetylene pressures as well as high oxygen pressures and the resulting gas ratio which is a measure of the flame characteristics was high.

The Air Reduction Sales Company, recognizing the fact that the healthy growth in any industry is only obtained through the advancement of the art, maintain research laboratories at Jersey City and Elizabethport. The research activities of this company are not, of course, limited to the work done in the laboratories but include to a large extent work done in the field under the direction of the Engineering Research Department.

The Engineering Research Department makes direct contact with the users of the process and through the Applied Engineering Department instruct the user in the power application of the process to affect the greatest economies. Under the direction of this department there has been constructed and put in successful operation a number of automatic welding and cutting machines. The Engineering Research Department is organized with the primary object of aiding the customer.

The present discussion will be largely limited to the work of the laboratories.

The Research Engineers in the Apparatus Research and Development Department at Jersey City have at their disposal besides the usual metallurgical and chemical equipment, physical testing machines, gas measuring instruments, etc., a completely equipped machine shop independent of the manufacturing department. The work of this department may be classified as follows:

1. *Work for Customers*

This work is usually of a more or less confidential nature, but in general consists in solving special problems dealing with the application of the oxy-acetylene process not only to welding and cutting but for many other purposes. It may consist of designing

*Presented before annual meeting of the A. W. S., April, 1927.

†Engineer In Charge of Apparatus Research & Development Department. Air Reduction Sales Company.

and constructing special apparatus to meet a particular need or, as is more often the case, demonstrating how apparatus already available may be used to accomplish the results desired, but in some cases apparently simple problems submitted to the laboratory lead into extensive metallurgical and chemical investigations.

II. *Development of Apparatus*

This may be sub-divided into two headings:

(a) Development of Apparatus for resale.

(b) Development of Apparatus used in the manufacture and handling of the gases used by the industry.

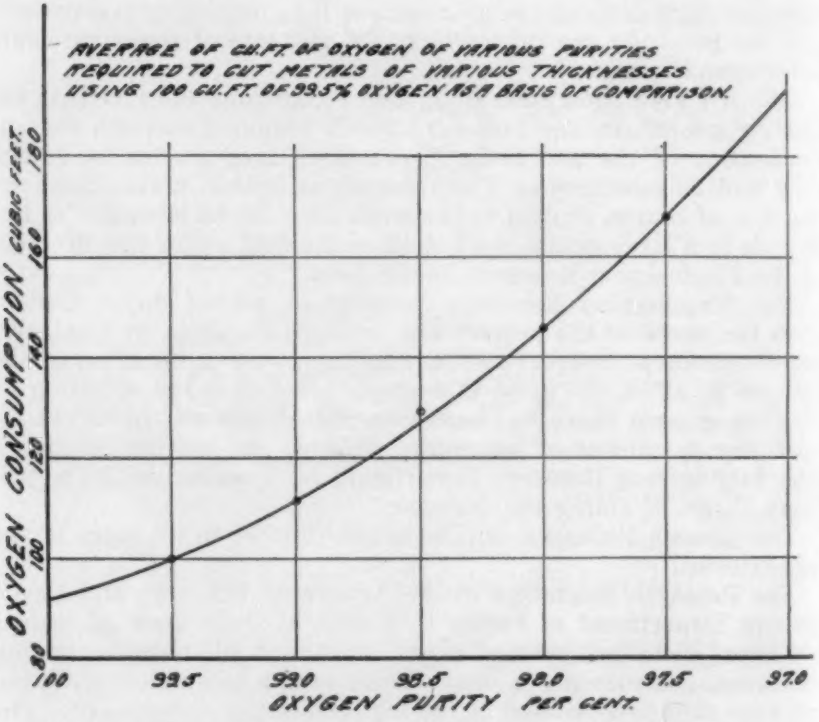

Fig. 1. Relation of oxygen consumption to purity

Most of the work under (a) is done by the Apparatus Research & Development Department cooperating with the other interested departments of the company, and while part of (b) is done by this same department, the larger part is done by our Elizabethport Laboratories and some of it in cooperation with other manufacturers and users acting through the medium of the various technical societies. A good example of this latter work being the standardization of hose connections done through the medium of the International Acetylene Association.

III. *Study of the Gases Used by the Oxy-Acetylene Industry*

The laboratory is constantly studying the gases used for cutting and welding and the methods of using these gases with the view of obtaining the highest efficiency in their application.

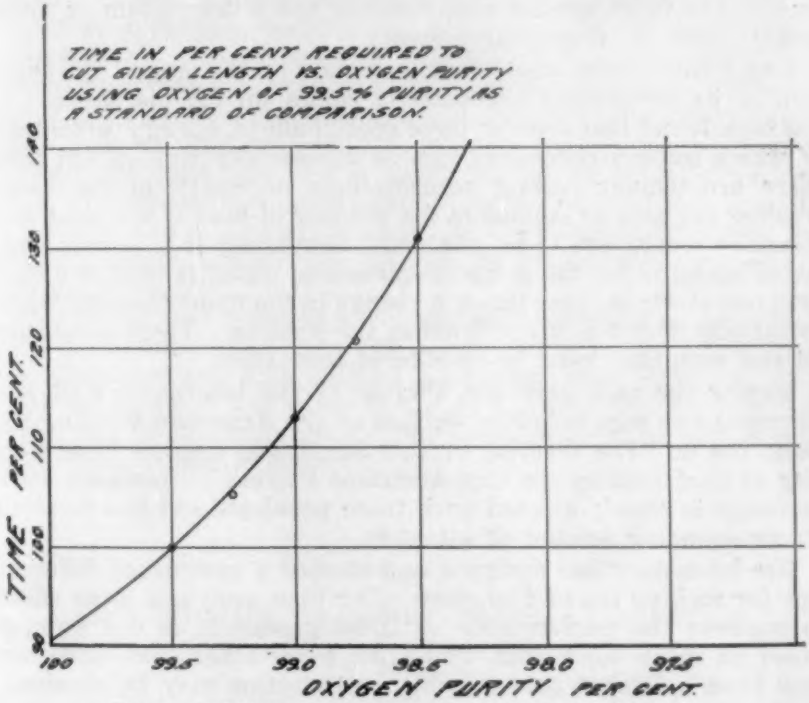

Fig. 2. Relation of oxygen purity to time of steel cutting

IV. *Fluxes*

This includes the study and development of fluxes used in the welding aluminum, bronze, cast iron and special steels, etc.

V. *Inspection*

The inspection is closely aligned with the preparation of specifications and covers not only the materials used in the manufacture of apparatus and equipment, but includes welding rod, hose, goggles, etc.

Torches have always received considerable attention by the laboratory, and in the latest development exceptionally high gas flows have been obtained at low acetylene pressures with a material reduction in the gas ratio. In the new torches the gas ratio, that is the ratio of the volume of acetylene to the volume of oxygen used by the torch has been reduced to a ratio of 1.00 to 1.01, the theoretical ratio on the assumption that both gases are 100 per

cent pure, being 1.00 to 1.00. With the low gas ratio the flame obtained has ideal characteristics for most classes of work, but there are exceptions and we have found that for some operations a somewhat higher gas ratio than 1.00 to 1.01 may be desirable.

Numerous special tips and torches have been designed and manufactured to fulfill special requirements, but a description of these would hardly be of general interest.

Every time a new steel or alloy appears on the market the question of its weldability immediately comes up for discussion. It has been found that most of these special alloys, a large percentage of which contain chromium, can be successfully welded, but that there are usually certain modifications necessary in the usual welding methods as applied to the welding of steel if the most satisfactory results are to be obtained. Sometimes it is a mere matter of allowing for the proper contraction, which is usually different from steel; at other times, a change in the flame characteristics or the addition of a flux will aid in the welding. There is no cure all and each case must be considered separately.

During the past year Mr. Walker of the laboratory staff has delivered two papers before sections of the American Welding Society, one on "The Welding of Tool Steel" and another "The Cutting of Cast Iron by the Oxy-Acetylene Process." Research work on fluxes is closely aligned with these problems and has received a corresponding amount of attention.

The laboratory has designed and studied a number of different tips for making use of fuel gases other than acetylene in an effort to improve the performance of these gases. It is our opinion based on much work that while fuel gases other than acetylene may have a limited field in which satisfaction may be obtained, the best and most efficient fuel gas is acetylene. The most important work done by the laboratory in the study of gases has been the subject of "Oxygen Purity vs. Cutting Efficiency." As we showed by data in a paper presented before the Society some time ago, an increase in oxygen purity from 99.00 per cent to 99.50 per cent decreases the time required to make a given cut by over 10 per cent, and at the same time reduces the time required to make the cut by a corresponding amount or expressed on the basis of equal time the oxygen consumption is reduced by something over 20 per cent.

A study of the effect of preheating oxygen has also received some attention, and while this work has not been completed, the results obtained would appear to justify the statement that "within commercial limits no advantages in efficiency as measured by oxygen consumption are obtained by preheating the oxygen."

Most of our development work on welding rod has been along the line of improving the welding characteristics of the old compositions rather than the development of new compositions, although a number of new compositions have been studied. As the

result of these studies not near so much importance is now attached to the chemical composition as was formerly the case. Unfortunately the usual chemical analysis is of very little use in forecasting the welding properties of welding rod. This is due to the fact that the occluded gases, slag, etc., which have an important bearing on the welding characteristics of a material are not included in a routine analysis and are very difficult to determine quantitatively even by research methods. Our present method of inspection includes a chemical analysis of the heat from which the rod is to be made, a check analysis on representative billets and a flame test for flowing qualities on each coil of rod as it goes through the mill, and this is supplemented by actually welding tests. Using representative samples from each delivery, coupons are welded and after machining to size are tested to determine the tensile strength, and all rods not meeting the specification requirements are rejected.

One of the new fields in which oxygen is playing an important part is blasting. As a result of a very extensive investigation in the laboratory and field tests on a practical scale extending over a period of years liquid oxygen (L.O.X.) is now being used in preference to dynamite for certain classes of blasting with a very appreciable saving in costs.

Electrically Welded Steel Penstocks

T. UJÜYE†

Following this progress of the world, the use of electric welding has become quite general in all kinds of enterprises, such as shipbuilding, boiler making, pipe making, civil engineering, improvement of architecture and industrial structures and general sources of power supply, such as lakes, rivers, ponds, swamps and springs are now utilized to such an extent that we have never experienced before.

The utilization of electric welding as a substitute for riveting is one of the most important developments.

From this point of view it is desirable for the development and progress of our industry that we have ample experience and demonstrations of the application of electric welding.

Our company in Japan has made every endeavor to solve this problem. An expert engineer and an experienced workman were dispatched to Sweden some years ago for the purpose of making investigation of electric welding there.

A remarkable feature of recent development in mild steel weld-

†Kobe Works, Mitsubishi Zosen Kaisha, Ltd., Kobe, Japan.

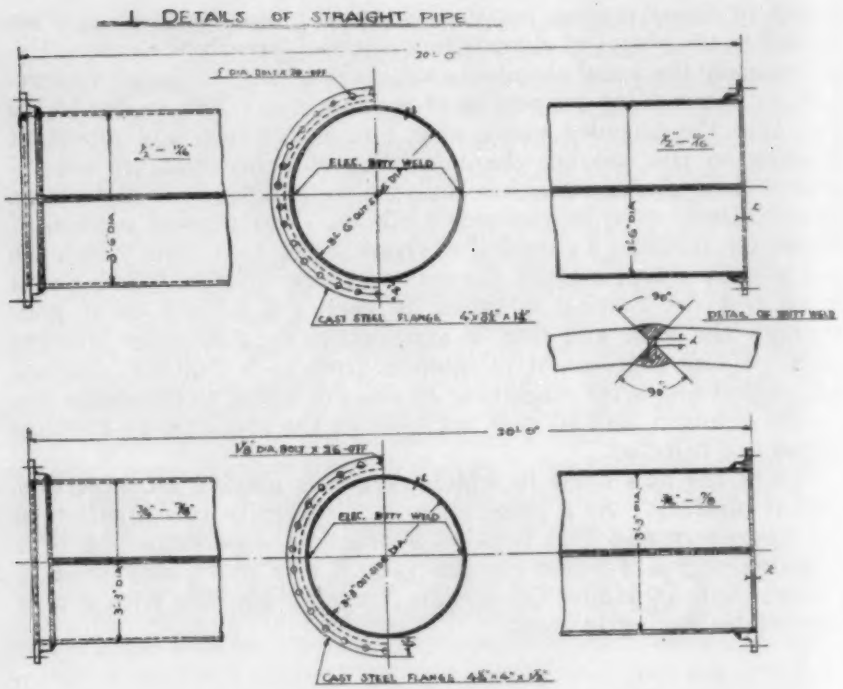

Fig. 1. Details of straight pipe

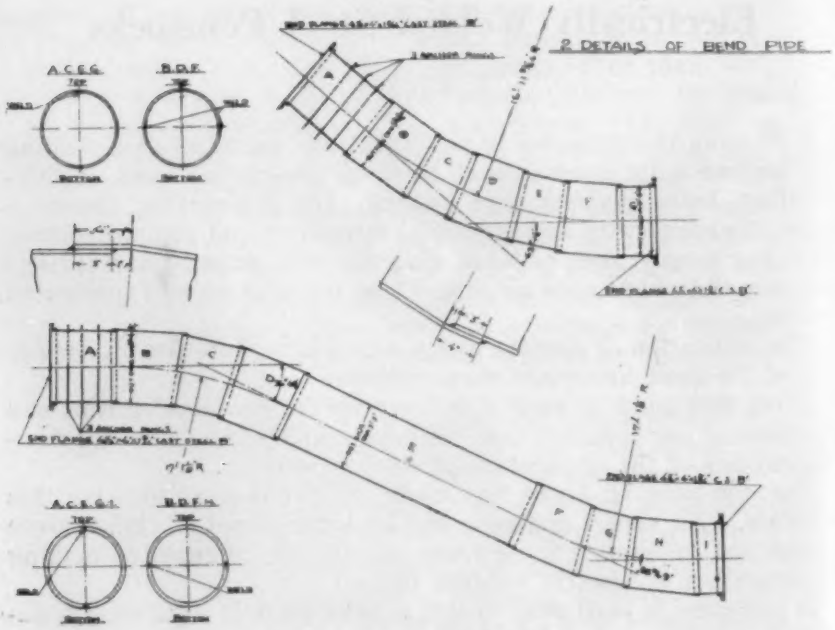

Fig. 2. Details of "bend" pipe

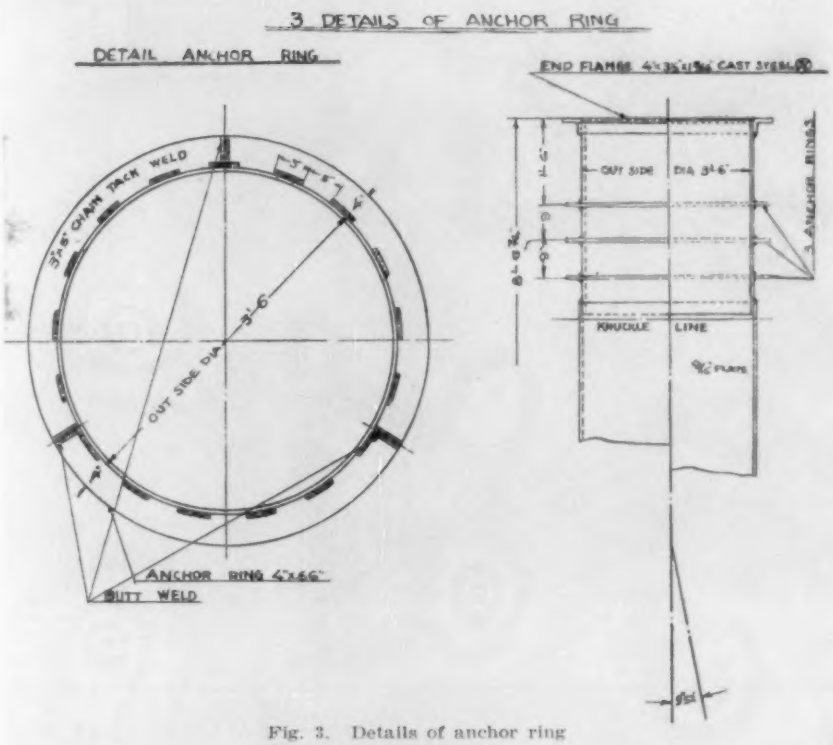

Fig. 3. Details of anchor ring

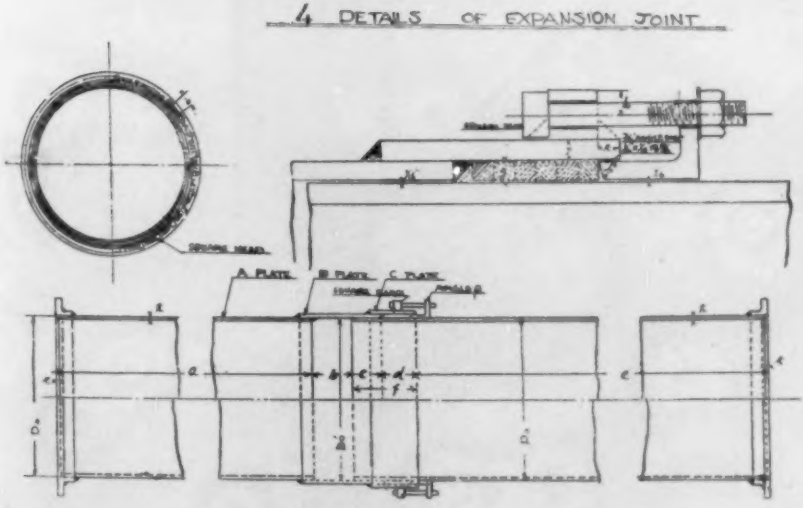

Fig. 4. Details of expansion joint

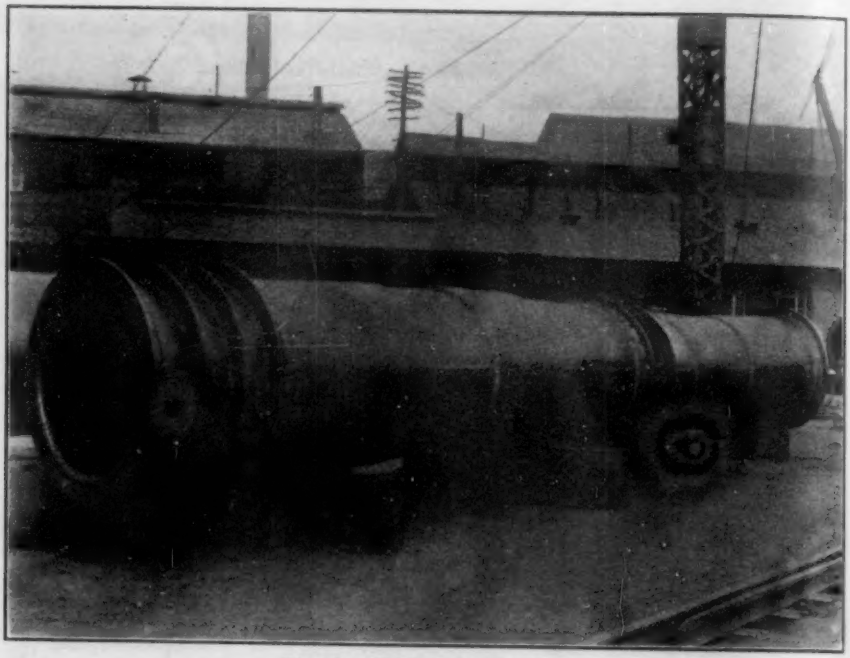

Fig. 5. Welded "bend" pipes

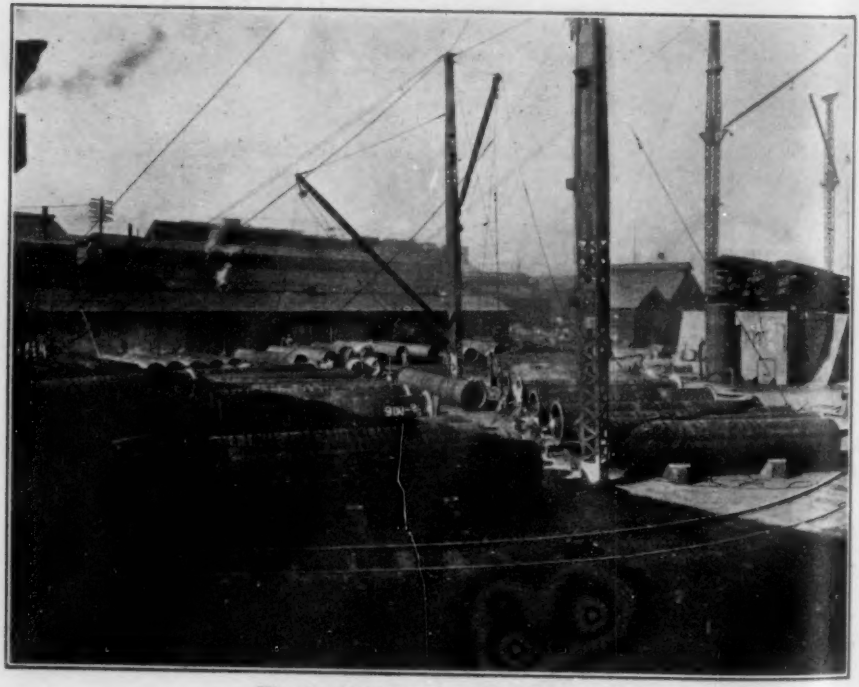

Fig. 6. Sections of welded Penstock

ing is the success attained in welding steel or wrought iron pipes. At first the application was limited to steam, oil, gas or water carrying penstocks on small scales and gradually the range became enlarged.

Riveted joint weakens the pipe at the hole, and flanges or caulked joints are loosened by constant strains or vibration, so that it is not unusual to cause a loss of 10 to 20 per cent of water by leakage from lines having such joints.

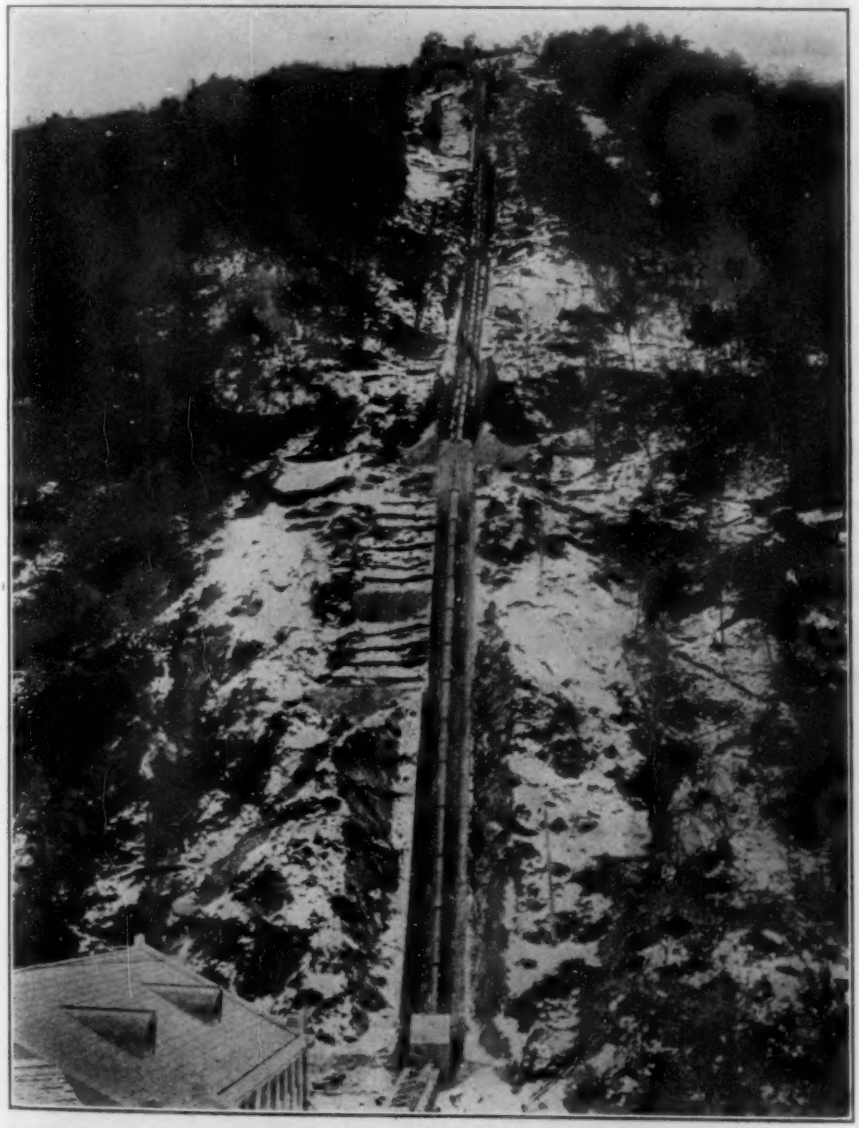

Fig. 7. General view of Penstock and power stations

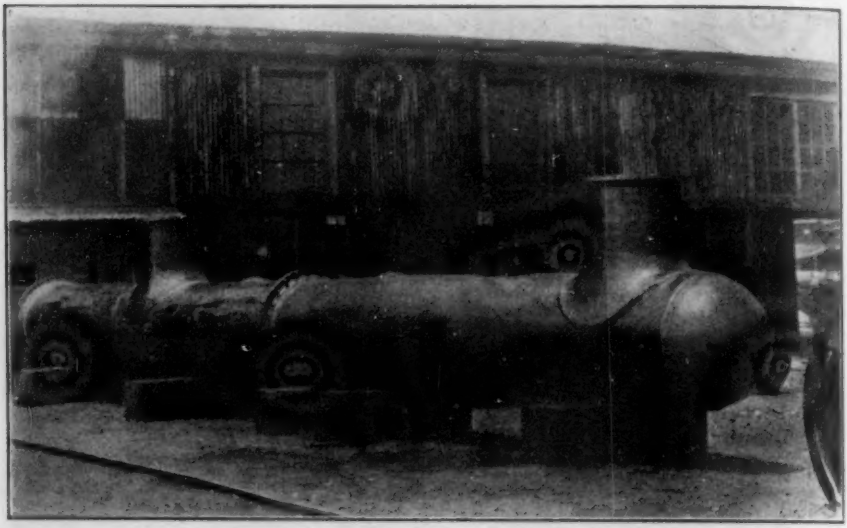

Fig. 8. Branch pipe for turbines

ELECTRICALLY WELDED STEEL PIPE FOR AZUMI ELECTRIC CO., LTD.

Pipe Thickness	Pipe No.	No.	Length	Outside Diam.	Kind	Max. Statical Head	Max. Statical Pressure Lbs. per Sq. In.	Test Pressure Lbs. per Sq. In.	Remarks
1/2″	No. 1-6	6	20′0″	3′6″	Straight	565′	245	368	
1/2″	No. 7	1	12′0″	3′6″	Straight				
9/16″	No. 8	1	18′11 5/8″	3′6″	Bend				
9/16″	No. 9	1	32′0″	3′6″	Exp. Joint	654′	283	425	
9/16	No. 10-15	6	20′0″	3′6″	Straight				
5/8″	No. 16-22	7	20′0″	3′6″	Straight	744′	322	483	
5/8″ x 11/16″	No. 23	1	32′0″	3′6″	Exp. Joint				
11/16″	No. 24-30	7	20′0″	3′6″	Straight	826′	358	537	
11/16″	No. 31	1	20′0″	3′6″ 3′3″	Tapered				
3/4″	No. 32	1	19′3″	3′3″	Bend				
3/4″	No. 33	1	40′0″	3′3″	Exp. Joint	918′	398	597	
3/4″	No. 34-37	4	20′0″	3′3″	Straight				
13/16″	No. 38-43	6	20′0″	3′3″	Straight	1,000′	433	650	
7/8″	No. 44	1	20′0″	3′3″	Straight				
7/8″	No. 45	1	19′2″	3′3″	Bend.				
7/8″	No. 46	1	40′0″	3′3″	Exp. Joint				
7/8″	No. 47-50	4	20′0″	3′3″	Straight				
7/8″	No. 51A	1	18′1 1/8″	3′3″	Bend				
7/8″	No. 51B	1	16′4″	3′3″	Bend	1,031′	447	670	
7/8″	No. 52	1	5′0″	3′3″	Straight				
7/8″	No. 53	1	20′0″	3′3″	Straight Branch				
7/8″	No. 54	1	18′0″	3′3″	Straight Branch				

Welded penstock does not require frequent inspection, and so the need for line walkers is largely eliminated.

The advantage of pipe welding has led to welding of high pressure water lines and our efforts in this connection have been rewarded with a considerable amount of success.

In order to gain practical experience in the application of electric arc welding on a large scale, the construction of 1146-ft. penstock was prepared by our works for the Azumi Electric Company to be used at their Nakafusa No. 4 power station in Nagano prefecture. The construction was to be undertaken by means of electric arc welding instead of riveting and when the work was completed it passed the severe survey of the clients as well as the survey of Japanese Communication Department.

The whole line was to consist of two pipes 625 ft. in length by 42 in. in diameter and 521 ft. in length by 39 in. in diameter. The pipes were made in sections 20 ft., thicknesses being 1/2 in., 9/16 in., 5/8 in., 11/16 in., 3/4 in., 13/16 in. and 7/8 in., and these pipes were subjected to a 368, 425, 483, 537, 597, 650 and 670-lb. hydrostatic pressure test for respective thickness, with the satisfactory result that no welded joints failed.

The chief reasons for using electric welding can be enumerated as follows: first, electrically welded pipes are cheaper than riveted; secondly, the use of welded joints greatly reduce the weight and also reduce the expense of punching and caulking; thirdly, welded joints enabled the reduction of the diameter of entire line about 1½ in., because the internal friction caused by rivet heads was eliminated; fourth, riveted construction requires continual inspection and repairing for the caulking, whereas such attention and subsequent expenses can be dispensed with in case of welding; fifth, the appearance of the welded line is much better and lagging can be applied in a more economical way.

The experiences gained from the above penstock are as follows: first, too much heat causes the metal to run very liquid and fly about, increasing the trouble of oxidation or burning; second, too little heat does not permit proper fusion because the mass is not at the point of welding heat; third, tight joints may be obtained without punching a single hole for holding bolts; fourth, after installing the penstock at the designated place and also after turning on water into the pipes no trouble or hindrance occurred; fifth, the result of flow of water was more satisfactory than ever experienced with riveted pipes.

A Study of Electrode Heating

By J. B. GREEN, M. E.*

As the art of metallic arc welding develops, it is quite natural that higher and higher current densities become common practice. In going to the higher densities made necessary by competition on welded products, the limit of current carrying capacity of the electrode will soon be reached and, in fact, has been reached in many applications. This calls for a study of the factors affecting electrode heating so that the electrode manufacturer and user may have a correct idea of the causes back of this heating and be able to judge intelligently when the real limit of current has been reached. Without a knowledge of these causes, a user might jump to the conclusion that he had reached the real limit while, as a matter of fact, it is only an apparent limit. He would thus deprive himself of the advantage either of an otherwise suitable electrode or high current or both.

The actual temperature attained by an electrode in use is dependent on the ratio of heat input to heat output together with the melting rate of the electrode. The input heat may be considered as coming from three sources, the electrode holder, the electrode and the arc. Among these the electrode holder today seems chargeable with most of the electrode heating. This is due to faulty contact either because of poor design in the first place or improper care in loading or keeping the holder clean. This situation is aggravated by the increasing popularity of surfaced electrodes. Surfaced electrodes being coated over their entire length, naturally make a metal to metal contact at the holder more difficult. The introduction of surfaced electrodes calls for modification or a new type of care in connection with such auxiliary apparatus as holders. Most trouble encountered on account of electrode heating today is traceable to the holder.

The heat coming from the voltage drop due to poor contact at the holder is almost wholly lost energy and, if excessive, also results in electrode loss, all of which is entirely preventable by the user. The heat coming from the voltage drop through the electrode is only partially lost and not preventable by the user except as he exercises judgment in selecting electrodes designed by the maker to give minimum losses. It is interesting to study, however, what affects the voltage drop through the electrode. There are three factors in this case. The diameter of the electrode, its chemical composition and its structure. The heating varies inversely as the square of the diameter. In Fig. 1 are shown a series of curves based on actual experiment which show this. The composition and structure of the electrodes were held constant, the diameter only being varied. It will be noted on these temperature-current curves that the small diameter electrode requires but a

*Research Department, Chicago Steel & Wire Company.

slight increase in current to cause a marked increase in temperature while the reverse is true of the large diameter ones. In Fig. 2 are shown similar curves, only here the diameter and structure were held constant while the composition, as represented largely by carbon content, was varied. It has been a known fact for years that composition affects the resistance of electrodes. This is again shown in Fig. 3, in which the curves for a number of alloys are given. Tests were also run on electrodes of the same type, but of different manufacture. Two common mild steel types were selected and two manufacturers of each type. The data is plotted in Fig. 4. There is a difference between types, but little differ-

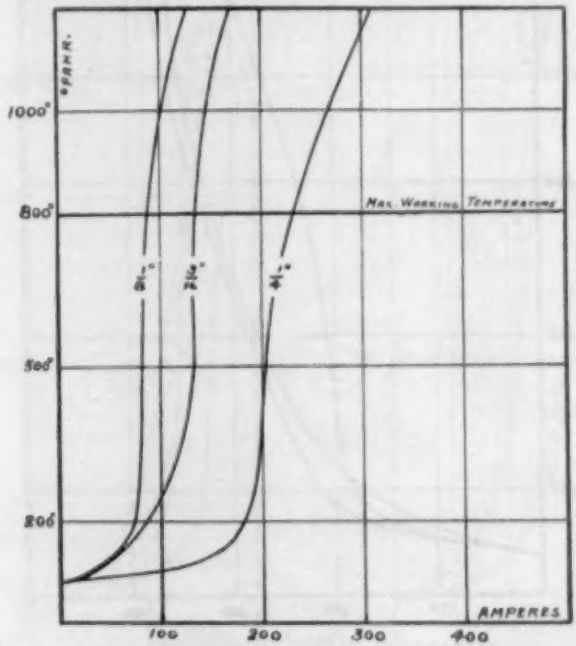

Fig. 1.

Effect of varying electrode diameter

ence as between manufacturers. Next, the composition and diameter were held constant while the structure was varied. An extremely high carbon electrode was selected for this test with a pearlitic carbide structure. The carbon in this electrode, after being tested, was spheroidized, thus converting it to the globular form, after which it was again tested. The curves in Fig. 5 plotted from this data indicate that the globular form of carbide results in an electrode which will carry a substantially higher current density. The heat from the arc itself is really all useful, so there is little incentive to study this from the standpoint of electrode heating. So much for the heat input.

Passing now to the heat output. This varies directly with the

diameter and is also affected by both the composition and structure of the surface as well as by the temperature gradient or difference in temperature between the electrode and the surrounding air. Heat must be viewed from the standpoint of both quantity and intensity, the quantity being measured in B.t.u., calories, or watts, and the intensity by degrees of temperature. If the heat input and output exactly balance there will be no change in temperature. The situation is analogous to a tank into which a stream of water flows at the top and out through a pipe at the bottom. If more water flows in than out, the level in the tank rises, increasing the

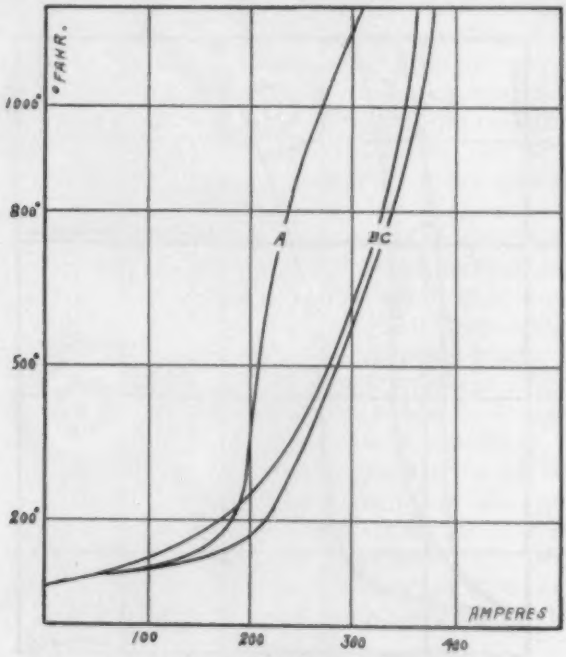

Fig. 2.
Effect of Electrode Composition
A - Carbon .06 Manganese .12
B - " .16 " .45
C - " 1.00 " .45

pressure at the outlet which, in turn, increases the quantity of water leaving the tank. Finally the height of water in the tank becomes such that the pressure head will force out just the same quantity of water as flows in. The system will then be in equilibrium. The height of water in the tank is spoken of as the pressure head and is analogous to the temperature. The effective pressure head is really the difference in pressure between that of the atmosphere tending to keep the water in the tank and the weight of water tending to force it out. This difference is analogous to the temperature gradient. Neither atmospheric temperatures nor pressures vary greatly under ordinary conditions, and so this idea of a gradient can in most cases be left out of consideration. It takes

an appreciable time for the water in the tank to reach an equilibrium level and so does it for the electrode to reach an equilibrium temperature. The capacity of the tank to hold water will affect this time and so will the specific heat or capacity to hold heat of the electrode affect the time to reach equilibrium temperature. All of the curves with this article are plotted for equilibrium temperatures without regard to the time required to reach them. In actual practice higher currents can be used than those shown on the

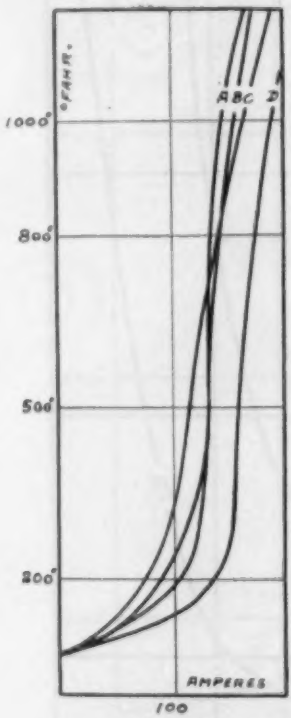

Fig. 3.
Effect of electrode composition
A - Pure Iron
B - 14% Manganese
C - 14% Chromium
D - 3-1/2% Nickel

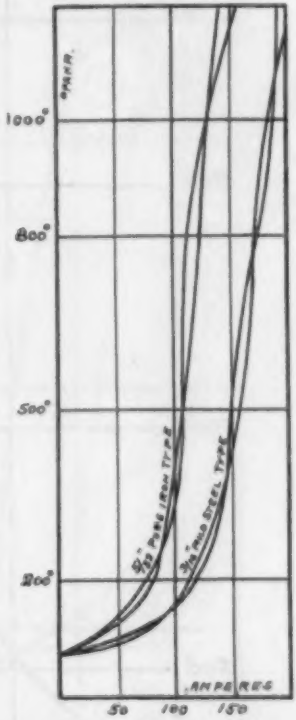

Fig.4.
Products of Different Manufacturers
Pure Iron-Weldite No6 and Armco
Mild Steel-Weldite No18 and Roebling

curves because the electrode often is used up in less time than that required to reach the equilibrium temperature.

In studying the effect of surface on electrode heating a highly polished rod was used as a control for comparison. In Fig. 6 are shown the curves for such an electrode, together with the ones for a surfaced electrode and a bare one. It might be mentioned here that a full flux coated electrode gave a curve so nearly identical with the surfaced one that it would be confusing to plot it on the same sheet. It will be noted that much less current is required

to heat the bare electrode to a given temperature than either the polished or surfaced ones. This is quite the opposite to what most engineers might expect, as the bare electrodes are rougher than

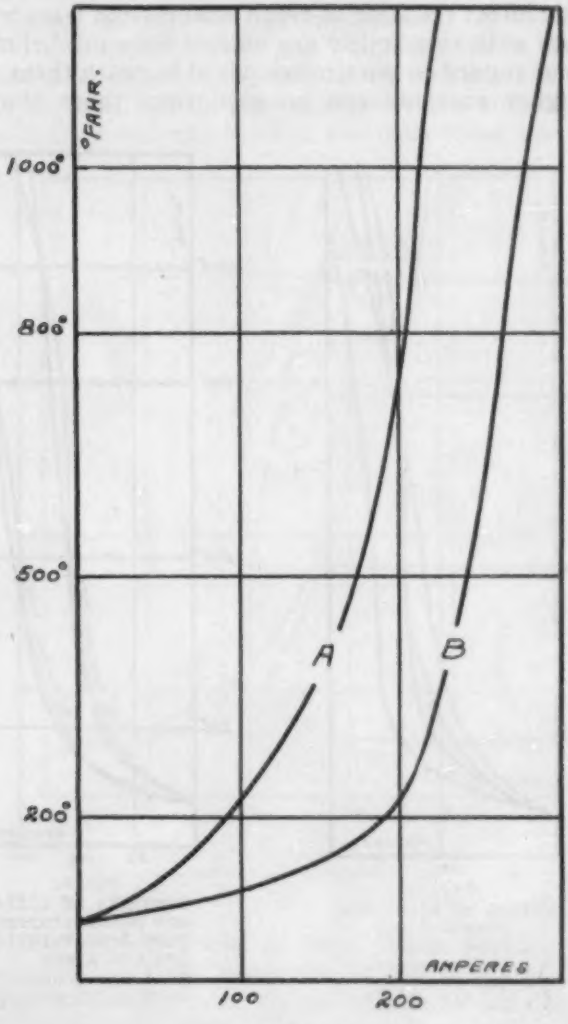

Fig. 5.
Effect of Electrode Structure
A - Pearlitic
B - Globular

the polished and have less heat insulating material than the surfaced or flux coated.

All of the curves shown so far have been carried only to 1200 deg. Fahr. because this is above the temperature at which electrodes should be run. Most of the experiments on which this

article is based included runs up to nearly the melting point of steel and one such complete curve is shown in Fig. 7. A surfaced electrode is selected for this curve because it shows more critical

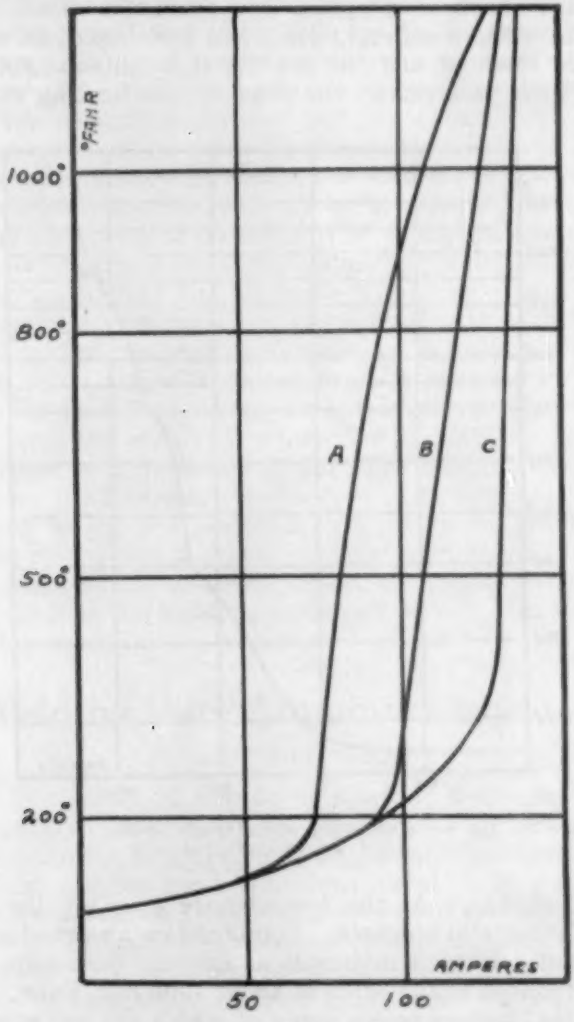

Fig. 6.
Effect of Electrode
Surface

A - Bare
B - Green Surfaced
C - Polished

points, including those due to both the surface and the electrode metal. It must be remembered that metals are first class conductors and consequently their electrical resistance increases as the

temperature is raised. Then, too, iron assumes different forms at different temperatures, metallurgists calling these forms by Greek letters, χ, β, γ. They are analogous to the three forms of carbon, viz., charcoal, graphite and diamond. Each one of the forms of iron has a different electrical resistance; so, as the temperature is elevated and the iron is thus automatically changed from one form to another, the slope of the heating curve can be

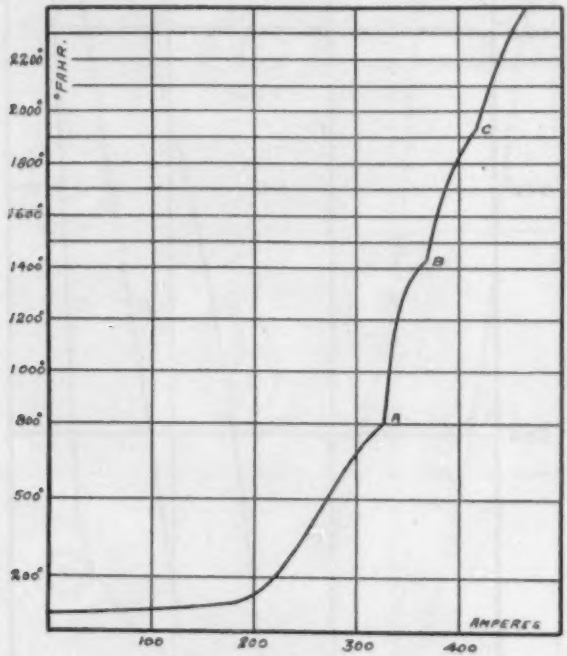

Fig. 7.
Illustration of Critical Points
A - Due to surfacing
B and C - Due to steel

expected to change. As the temperature goes up, the character of the surfacing also changes. Combined or absorbed water may be driven out. If such materials as calcium carbonate are present, this is reduced to the oxide at about 1000 deg. Fahr., and many other complex changes occur, many of which are not reversible, as the electrode is again cooled down. Thus, an overheated electrode end which has been laid aside to cool, if again used, will not necessarily work the same as one which has not been so overheated.

There is one more very important factor to be considered in connection with electrode heating and this is the melting rate of the electrode. It has already been brought out that an appreciable time is required at any given current for an electrode to reach equilibrium or in other words maximum temperature. If the electrode melts so fast that it is entirely consumed in less time than is required to reach the maximum temperature, it is easy to appre-

ciate that in practice a higher current may be safely used than is indicated by the curves with this article. About 600 deg. to 800 deg. Fahr. is as hot as electrodes should be run if damage to the electrode and holder are to be always avoided. At these temperatures the electrode will just show dull red to the naked eye in a darkened room. This fact makes possible a very simple practical test which any shop supervisor can readily conduct to determine for himself the maximum current carrying capacity of any size and type electrode. Very carefully polish both ends of the electrode so that perfect electrical contact is assured and short circuit it, using a relatively low current. Now increase the current very slowly, taking a reading of the current at which the electrode just begins to show color in a darkened room. This will be the maximum equilibrium current the electrode will carry. Now increase the current about 10 amperes and run a bead with a similar electrode, always taking care that perfect contact is made at the holder. Stop the run while a few inches of the electrode are still unconsumed. Repeat this, increasing the current each time by about 10 amperes until the stub end, when viewed with the naked eye, just shows color in a darkened room. The current used for the final run where the first color is observed will represent the maximum amperes which the electrode will carry in practical use. The supervisor who has a record of this current will, when his welders complain of the electrode's heat, be able to definitely say whether or not it is the welder's fault and be just that better able to manage his shop.

Welding Pure Aluminum Sheet

T. C. FETHERSTON†

With the popularity of non-ferrous metals for a multitude of modern industrial uses comes the problem of fabricating these with a satisfactorily tight and strong joint. Commercially pure aluminum is one of the most important metals in this group, and so demands consideration from everyone who uses it either for special purposes or in routine production of modern plant equipment.

Oxy-acetylene welding is employed to give permanent tightness at the seams in equipment made of aluminum. It is not easy to fabricate aluminum sheet by riveting because aluminum rivets stretch easily, and because the sheet itself should not be weakened with rivet holes. These difficulties are in addition to the usual disadvantages of riveted joints, especially in equipment for processes where extraordinary demands are made upon the seams with regard to the qualities of tightness and corrosion resistance.

It might be well to note at this point the fact that some of the things outlined in this article which correctly apply to commercially pure aluminum (99 per cent + aluminum) do not apply to

†Technical Publicity Dept., The Linde Air Products Co.

aluminum alloys which, as far as the process of welding is concerned at least, demand separate consideration.

Approximate strength of the original material is frequently demanded in fabricated sheet aluminum. An outstanding example of articles subjected to such service are the variety of tanks used

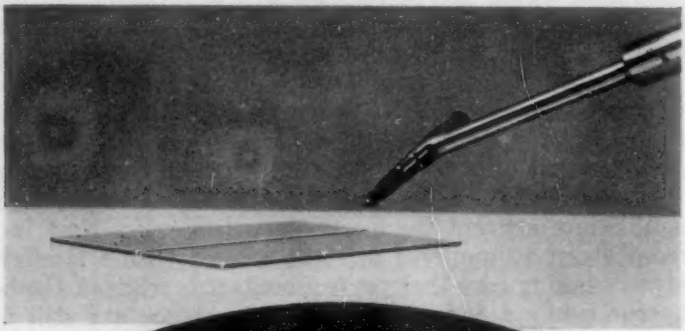

Fig. 1 (above)—The blowpipe head should be at an angle of 30 deg. to the sheet surface

Fig. 2 (below)—Notice position of the blowpipe

in aircraft. These must of necessity be light, must conform to space limitations, must be absolutely tight under adverse conditions, and must be strong. That acetylene-welding fulfills all these requirements is strikingly illustrated by the fact that practically every aluminum airplane tank manufactured in America is built with oxy-acetylene welded seams.

The welding of sheet aluminum is not difficult, but it requires

some knowledge and experience on the part of the operator to produce uniformly good welds day in and day out under varying conditions. An operator, even though experienced on steel and cast iron, who is attempting to weld aluminum sheet for the first time, should certainly obtain some of this material and make practice welds which he can test to destruction. Thoroughly satisfactory results on sample pieces should be obtained before undertaking important work.

Welding practices and the general methods of preparing material for welding vary little for aluminum sheet and light plate up to about $\frac{3}{8}$ in. thick; except for the usual provisions for handling very light gage material.

Of utmost importance in this work is selection of the proper material for welding. In general, sheet aluminum differs from the cast metal in composition, the latter being alloys containing important percentages of other metals, while the rolled material is pure aluminum, 99 per cent pure or better. This difference demands a different welding technique; and welding rods prepared for welding cast aluminum are not suitable for pure aluminum sheet.

In addition to this, aluminum sheet and plate is made in a number of grades and tempers; these varying considerably in physical properties and weldability. As an example, 16-gage sheet of one grade varies in tensile strength from 18,000 lb. per square inch to 37,400 lb. over the temper range from "0" to "Hard." On the other hand, ductility of the same material (which varies inversely with the tensile strength) ranges from 26 per cent elongation to 4 per cent. Brinell hardness shows a variation from 32 to 66. It is therefore suggested that those contemplating production work in aluminum obtain the recommendation of the manufacturer of the sheet before ordering the material. These people will be glad to advise on the proper grade, temper and thickness of sheet or plate if given some details about the design of the product.

Where castings for outlet connection, manhole flanges and other purposes are to be welded to sheet or plate, pure aluminum castings should be purchased. These will be nearer the composition of the sheet, and can be welded into place with drawn aluminum welding rod and sheet aluminum flux.

Aluminum differs from most metals in that it does not change color through its entire heat range. That is, it does not become red hot, but maintains its characteristic silvery white color even in the fluid state. The metal oxidizes very rapidly, and the resulting oxide has a melting point much higher than the melting point of aluminum metal. The oxide is also lighter than the metal itself, and consequently forms on the outside of the weld in a heavy thick skin. This oxide coating is removed from aluminum sheet by means of a proper flux when it becomes so heavy as to interfere with welding.

Aluminum, like copper, has a very high rate of thermal conductivity, and consequently the heat of welding is rapidly absorbed by the metal near the weld. This makes it desirable to support carefully all parts adjacent to the weld that are likely to become rapidly heated, and to complete the weld as quickly as is consistent with good workmanship, using a flame of minimum size.

Proper flux and welding rods are of the utmost importance. A flux is necessary to control the oxidation of the metal described in the foregoing paragraph so a sound weld can be made. It is desirable to use the best quality rods that are obtainable because rods formulated exclusively for welding are planned and made with a

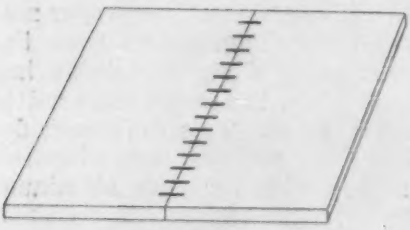

Fig. 3. Light plate prepared for welding by notching

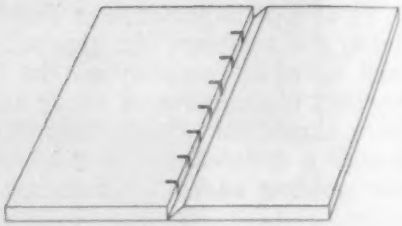

Fig. 4. One edge notched, the other bevelled at 45 deg.

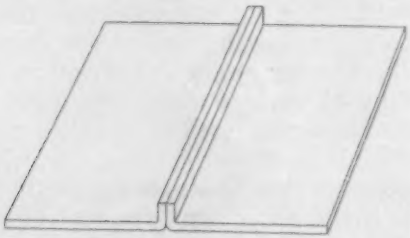

Fig. 5. Light sheet flanged the thickness of sheet

full knowledge of welding requirements and are designed to give correct composition of metal *in the weld*. A few cents extra paid for good aluminum welding rods are well invested in insurance against unsatisfactory results.

Where emergency work must be done before welding rods can be delivered it may be possible to do an acceptable job with strips cut from the sheet to be welded. The practice of using such material, however, is to be discouraged. It is undesirable under any conditions to use ordinary aluminum wire as welding rod because of the variation in composition to be found in material of this class.

Good flux is also important, probably more so in aluminum welding than in work on any other metal.

Most aluminum fluxes are sold as a thick paste or powder. These are then mixed with water to a free-flowing consistency and ap-

plied with a brush to the welding rod. Where no welding rod is being used, flux is ordinarily brushed on the edges of the sheet.

There are other methods for introducing required quantities of flux into the weld. In some shops a flux container is made by welding a piece of 3-in. pipe to a base plate, the pipe being about the same length as the welding rods. This container is kept filled up to within an inch of the top with a flux and water solution, and the supply of welding rods is kept in this. Sufficient flux will cling to the rods when withdrawn for use.

Light aluminum sheet (about 16 gauge and lighter) is usually flanged in preparation for welding. The flange should be about

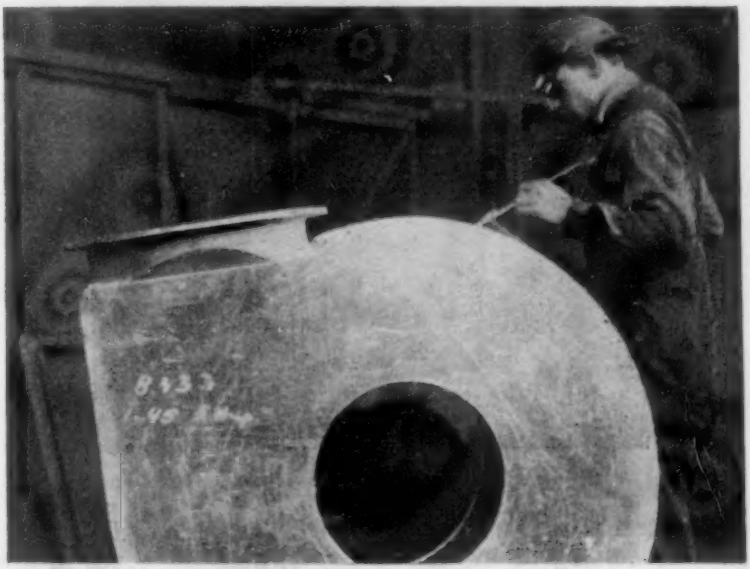

Fig. 6. Blower housing made of light aluminum plate

the same height as the thickness of the sheet or just a little higher. The joint is made by holding the two upstanding edges together and melting these down. For such work as this no welding rod is required.

Heavier sheet and light plate can be welded with a plain butt weld. Beveling is unnecessary for light plate. Welding rod can be used if it is desirable to reinforce the weld. In some instances it can be dispensed with entirely. Thicker sections can be beveled as is usual with steel plate.

A design of joint which has many advantages is sketched in Figs. 3 and 4. The essential feature is notching the edges at intervals. In sheet $\frac{1}{8}$ in. thick and heavier, the edges are cut through the entire thickness. These notches are about as deep as the thickness of the material, and are made as close as $\frac{1}{4}$ in. apart in $\frac{1}{8}$-in. material. The edges are butted close together.

With the sheet or plate so notched, it is easier to obtain full penetration. The flux works down for the full thickness of the material, and considerable welding rod is saved. There is less chance of "burning through" and the notches act also as little expansion joints, preventing undue local distortion.

In ¼-in. and ⅜-in. material, one of the abutting edges can be notched this way, while the other is beveled 45 deg. as shown in Fig. 4. This design has the advantages of the one just described; at the same time it is practicable for heavier material.

In all of this work the assembly of parts before welding should be gone about as in welding steel sheet of the same thickness

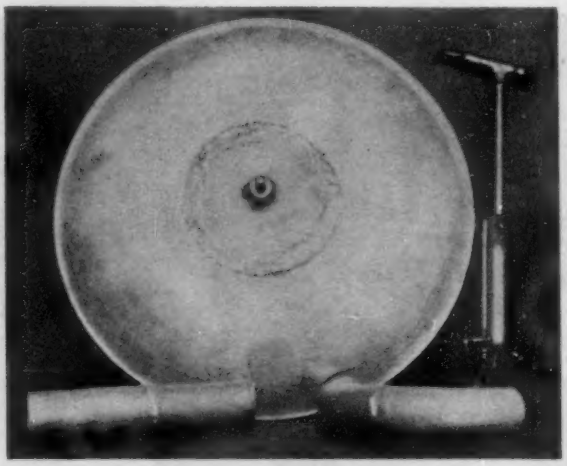

Fig. 7. Spun disc welded to cast pure aluminum outlet flange

Long seams will require spacing at the far end, or they may demand tack welding or the use of jigs to hold the edges in proper relative positions. For welding very light metal prepared by flanging, spring clips are often used. H-clamps of one kind or another are usually a great aid to the operator on material which is to be butt-welded with or without beveling.

Use of heavy bars or rails along the edges of the sheet to help reduce the heat effect is recommended for some classes of work. Where work is done in production, careful study of the matter of design and construction of jigs and fixtures will well repay the effort and expense involved.

While it is probably desirable to prevent undue distortion in welding aluminum, this is really not a serious matter. A good weld in aluminum sheet will be as ductile as the sheet itself, so if the finished object is slightly distorted it can readily be reshaped by hammering after welding is completed.

When material of good welding quality has been provided, and the operator is supplied with welding rods and flux of proper quality and composition, and when the joint has been properly de-

signed and set up for welding, the technique of actual blowpipe manipulation becomes the matter upon which the success of the weld depends.

For welding sheet aluminum the blowpipe should be carefully adjusted to show a neutral flame, as this gives the best speed and economy.

Keep the blowpipe at an angle of about 30 deg. to the surface of the sheet. This will prevent rapid melting of the metal in a restricted area, and will thus avoid welding holes through the sheet. Holding the blowpipe at this angle will envelope the metal well ahead of the point of welding with the outer cone of the blowpipe flame and so will make welding progress more rapidly. The operator should be careful, of course, that the weld penetrates the full thickness of the sheet, but should avoid stopping the blowpipe in

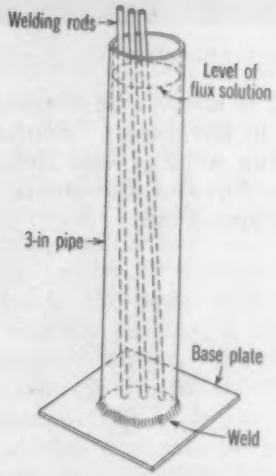

Fig. 8. Welding rod holder also applies flux to rods

any one position for a sufficient length of time to melt holes through the sheet.

Watch the metal carefully for signs of melting, and fuse the weld metal thoroughly with molten metal from the sheet. It is not possible to determine the melting point solely by the color, because, as mentioned before, aluminum does not change color. An operator will quickly learn to recognize the proper time to add weld metal.

A skin of aluminum oxide will quickly form on the melting metal. When this film becomes so thick that it interferes with welding, apply extra flux.

Completed welds are sometimes washed with a 10 per cent solution of sulphuric or hydrochloric acid to remove all trace of excess flux. After this treatment, welds should be scrubbed in large volumes of warm water to remove any of this acid solution that might be left.

Another method of flux removal consists of thoroughly washing the article in hot soapy water followed by a thorough hot

Fig. 9. Automobile bodies are often built of welded aluminum sheet

rinse. Where the weld is later to be dressed down and painted, a steam jet can be used to advantage. Sometimes little pockets of flux are entrapped during welding, and these are difficult to eliminate by washing. The force of the steam jet, however, is sufficient to remove the entrapped flux.

Standardization of Goggles and Helmets

W. SPRARAGEN, TECHNICAL SECRETARY, A. W. S.

In accordance with a request of the Executive Committee of the American Welding Society an attempt was made by national headquarters to ascertain the needs for standardization in the matter of size and quality of glasses to be used in shields, helmets, goggles, etc., for the protection of welding operators. In order to obtain a proper cross section of industry, a questionnaire was sent to a selected list of ten railroads, ten welding shops, ten street railways, ten manufacturing plants and ten general users of the several welding processes, as well as manufacturers and distributers of protective devices.

An analysis of the answers to the questionnaire sent out indicate that the users employ anywhere from one to eight different sizes of glasses with most of them using one or two sizes. Out of the *forty* replies received from *users* thirty indicated that they desired standardization of size, while ten stated that they did not. Most of the glasses used are either 1⅞ inches or 2 inches in diameter round and 2 by 4¼ inches rectangular. Nearly all of the users favor standardization of quality of glasses. The manufacturers, on the other hand, were equally divided on the question with a small majority against standardization both as to size and quality.

After considering this report, the Executive Committee suggested attention be called to the desirability that industry standardize on two sizes of glasses, namely, 2 inches in diameter and 2 inches by 4¼ inches rectangular. It was further suggested that extracts from Bulletin No. 2 of the Bureau of Standards, dealing with the National Safety Code for the protection of the heads and eyes of industrial workers, be published at the same time. Pertinent abstracts are therefore reproduced below.

Abstracts* from National Safety Code for the Protection of the Heads and Eyes of Industrial Workers

(*Published by the U. S. Bureau of Standards as Bulletin No. 2 of Handbook series.*)

SEC. 9. PROTECTORS FOR OXY-ACETYLENE WELDING, FURNACE WORK, ETC.

GROUP H

91. *Goggles of Style No. 1 or 2*

To prevent burning, a heat-insulating material which can be sterilized without deterioration shall be used on all parts touching the face.

*The complete bulletin may be purchased from Superintendent of Documents Government Printing Office, Washington, D. C. Price 10 cents.

92. *Eyecup Goggles, Style No. 3*

Goggles shall consist of eyecups of non-corrodible opaque material, which can be sterilized without deterioration. They shall be shaped to fit the configuration of the face. They shall exclude light, except through the lenses, but shall afford adequate ventilation. Parts touching the face shall be made of heat-insulating material. The eyecups shall be connected by a flexible coupling which will permit ready adjustment, or else goggles shall be furnished in assorted sizes.

The coupling shall be covered with or made of heat-insulating material. It shall withstand sterilization or be easily renewable. Goggles shall have a headband or headgear of any suitable material which will retain the goggles in their proper position. Each pair of goggles shall bear some permanent distinctive marking by which its source may be readily identified.

93. *Face Masks*

(*a*) *Masks and Headgear.*—Face masks shall be of fiber or equivalent material, which can be sterilized without deterioration and be shaped so as to protect the face of the operator above the mouth. Face masks shall have a headband or headgear of any suitable design and material so as to retain the mask in proper position. Each face mask shall bear some permanent distinctive marking by which its source may be readily identified.

(*b*) *Lens Containers.*—If a single window is used in place of separate lenses, it shall hold glass the dimensions of which are not less than 4.25 inches (10.8 cm) in one horizontal direction and 2 inches (5.1 cm) in the vertical direction. Containers shall be designed to accommodate cover glasses to protect the lenses. The design shall permit ready renewal of lenses.

94. *Helmets*

Helmets of the design specified in rule 101 (*b*) are permitted.

95. *Specifications and Tests for Protective Glass*

(*a*) *Optical.*—Lenses shall meet the transmission test for radiant energy prescribed in rule 124 (*c*).

Lenses constructed of two parts may be used if the lower half conforms to the requirements of rule 124 (*c*).

(*b*) *Marking.*—Glasses, except cover glasses, shall bear some permanent distinctive marking by which the source may be readily identified.

(*c*) *Cover Glasses.*—Cover glasses should be provided to protect the lenses. They shall be substantially free from striæ, air bubbles, and other flaws, and shall have substantially parallel surfaces. (See also rule 16.)

SEC. 10. PROTECTORS FOR ELECTRIC ARC WELDING AND CUTTING

GROUP I

100. *Styles*

The helmet and the shield are the only permissible styles.

101. *Specifications for Protectors*

(*a*) *Helmets.*—Helmets shall be capable of withstanding sterilization (for test see rule 110) and shall comply with one of the following specifications:

(1) Pivotally Mounted Type.—The helmet shall be made of a material, which is an insulator for heat and electricity, shaped so as to protect the face of the operator, and curved back on each side beyond the ears. The helmet may be pivotally mounted on adjustable headgear, so arranged that it can be tipped back over the operator's head when not in use. The shield shall have a window frame to accommodate and hold securely rectangular windows, single or in multiple, of the dimensions specified in rule 102, together with a cover glass, and shall be so designed as to permit easy renewal of the windows. The total weight of complete equipment shall not exceed 24 ounces (680 g.).

(2) Shoulder-Supported Type.—The helmet shall consist of opaque material, which is an insulator for heat and electricity, arranged so as to rest on the shoulders and (or) chest and of such size and so shaped that it will protect the face from direct radiant energy. It shall be fitted with an opening to carry windows, single or multiple, of the dimensions specified in rule 102.

(*b*) *Shields.*—The shield shall consist of opaque material which is an insulator for heat and electricity. It shall be of such size and so shaped that it will protect the face from all direct radiant energy and shall be provided with an opening fitted to carry windows, single or multiple, of the dimensions specified in rule 102.

102. *Specifications and Tests for Windows*

(*a*) *Optical.*—Windows shall meet the tests for transmission of radiant energy prescribed in rule 124 (*d*). (See also rule 16.)

(*b*) *Dimensions.*—Windows for both helmets and shields shall have dimensions not less than 2 inches (5.1 cm) in the vertical direction and 4.25 inches (10.8 cm) in one horizontal direction. They shall be so mounted as to be not less than 2 inches (5.1 cm) from the eyes.

(*c*) *Marking.*—Glasses, except cover glasses, shall bear some permanent distinctive marking by which the source may be readily identified.

(*d*) *Cover Glass.*—A cover glass should be provided to protect the lenses. It shall be substantially free from striæ, air bubbles, and other flaws, and shall have substantially parallel surfaces.

103. *Protection for Other Workers*

A guard or shield shall be provided where necessary to protect other workers from exposure to the radiation from the electric arc, and no employee shall be required to work in such a position that his face is exposed to such radiation from any neighboring source.

It is recommended that permanent inclosures be supplied, where practicable, for arc welding and cutting.

124. *Optical Tests for Lenses*

(*a*) *Standard Source of Radiant Energy.*—The standard source

of radiant energy used for the measurement of transmission of visible light or total radiant energy shall be a 200-watt, 110-volt, gas-filled, tungsten-filament, electric incandescent lamp operating at 0.8 watt per spherical candle (approximate commercial rating).

(*b*) *Lenses for Group G.*—Lenses shall transmit not more than 1 per cent of radiant energy of any wave length less than 406 millimicrons. They shall transmit not more than 50 per cent of the visible light from the standard source.

(*c*) *Lenses for Group H.*—Lenses for helmet windows shall transmit not more than 1 per cent of radiant energy of any wave length less than 406 millimicrons. They shall transmit not more than 50 per cent of the total radiant energy from the standard source.

(*d*) *Windows for Group I.*—Helmet windows shall transmit not more than 1 per cent of radiant energy of any wave length less than 406 millimicrons. They shall transmit not more than 1 per cent of the visible light and not more than 10 per cent of the total radiant energy from the standard source.

DISCUSSION OF RULES.

124. *Optical Tests for Lenses*

The pathologic effect of ultra-violet radiant energy upon the animal tissues has long been recognized, but it is only in recent years that detailed studies have identified the harmful rays and their specific action. The skin as well as the eye is affected by ultra-violet radiant energy, especially when the intensity is high. The action is similar to sunburn. In such processes as arc welding, protection to the skin as well as to the eyes is necessary. Excessive brightness must also be avoided. Still another possible cause of impairment of vision might arise through the absorption of an excessive amount of heat energy by tissues and humors of the eye, but there is no evidence that the eye is more subject to injury in this way than any other part of the body. The injurious effect of infra-red radiant energy on the eye has never been definitely proven. However, protection against this is so easy of accomplishment that it seems desirable to provide it.

In order to provide complete protection it is necessary to limit the radiant energy in the ultra-violet to a negligible quantity; the brightness of the source must be reduced to a degree that no discomfort will ensue if work is carried on continuously; the radiant energy in the infra-red should be reduced so that it will not be unnecessarily large.

In order to be assured that adequate protection is provided it becomes necessary to know the optical properties of the glass used for lenses and windows. This is done by subjecting the glass to definite tests which, however, require special apparatus, the manipulation of which should be attempted only by experts.

Before proceeding with a discussion of the detailed tests it appears desirable to give a discussion of the method of making the

(a) *Standard Source of Radiant Energy.*—The standard source

tests in order that their application and limitations will be understood.

Light can be analyzed in a number of ways, the most familiar being by its passage through a prism of glass. This separates the waves of different wave lengths into a spectrum in which the different wave lengths appear as different colors. The visible spectrum ranges from the red to the violet. The waves outside of this range are designated as the infra-red on the one hand and the ultra-violet on the other.

When the light of different wave lengths is mixed together, the eye sums up the effect of the visible portion. Measurements of the intensity of the visible are made by means of the photometer, in which this intensity is compared by the eye with the intensity of the light from a standard source. For the portion of the radiant energy which is not visible other means must be used. Since when light is absorbed its energy may be entirely converted into heat, one of the most simple methods of measuring radiant energy, whether visible or not visible, is by means of a thermopile, where the absorbed light produces heat and this heat in turn produces a measurable electric current. The thermopile can be used to measure the total energy, or, if the radiation is analyzed into a spectrum, the energy of each particular wave length can be measured independently.

No glass transmits all of the light which is incident upon it, but some is always absorbed and some is reflected from its surface. Ordinary clear glass transmits a high percentage of the visible, but does not transmit either the very long waves or the very short waves. When glass appears colored it is due to the fact that it does not transmit all of the visible rays, but some of them are stopped by it. The transmission of glass is usually expressed as a percentage which gives the ratio of the amount of light transmitted to the amount which is incident upon it. This transmission is sometimes expressed in terms of the entire visible spectrum, sometimes in terms of a particular wave length which must of course be stated, and sometimes in terms of the entire radiant energy. It is measured by letting the light from a definite source fall upon the thermopile mentioned above and then interposing the glass whose transmission is desired. The ratio of the two deflections obtained will give the transmission.

The measurement can be carried out with any portion of the radiant energy from the source that may be desired. Thus one may use the total or one may spread the light out into the spectrum by the use of the prism and let only a single wave length or color fall upon the thermopile. Full details of the methods of making such meaurements will be found in Technologic Paper of the Bureau No. 119, entitled "The Ultra-Violet and Visible Transmission of Eye-Protective Glasses," and in Scientific Paper No. 325, entitled "Spectroradiometric Investigation of the Transmission of Various Substances." Much of the information in the

latter is also given in Technologic Paper No. 93, entitled "Glasses for Protecting Eyes from Injurious Radiation."

When the transmission for a particular wave length is measured it is almost immaterial what source of light is used, providing it can be kept constant during the measurement. Since the transmission for the total radiant energy is dependent upon the transmission for each particular wave length, and since the amount of energy which gets through will depend upon the amount of each particular wave length emitted by the source, it is evident that the result will depend upon the composition of the energy received from the source. It is consequently necessary when considering total transmission to have a definite and reproducible source of radiant energy. The value of transmission measured will depend upon the spectral distribution of the energy from the source. Consequently a source which is especially strong in light of one color and weak in light of another color will not be suitable. An example of such a source is a mercury-vapor lamp. A source of suitable spectral distribution would be the sun or some artificial source having a somewhat similar distribution and sufficiently reproducible.

For the tests here specified a source of light which is sufficiently reproducible and which is easily obtainable has been stipulated. This source is an ordinary incandescent lamp operated under specified conditions. The spectral distribution of the light from such a source changes somewhat when its operating temperature is changed. But this change is a gradual one, and slight changes in the operating temperature of a filament are not important. In order to make the source sufficiently definite it has been specified that it shall be operated at such a voltage as to consume 0.8 watt per spherical candle, which corresponds to the commercial rating of the 200-watt lamp. This commercial rating may, of course, be changed from time to time, but such change is not likely to alter the conditions sufficiently to make it necessary for it to be taken into account in testing lenses for compliance with these specifications.

If it is found that a lamp is operating at a slightly different specific consumption (watts per candle) at its rated voltage, correction may be made by operating at a slightly different voltage. Within a small range the change in watts per spherical candle is proportional to the voltage and amounts to 0.013 for 1 volt. Accuracy of adjustment is not important, as values of transmission are only slightly altered by large changes in operating voltage.

It is well to point out that such an artificial source is preferable to sunlight for several reasons. In the first place it is more convenient for use in the laboratory and is independent of the weather. In the second place, sunlight is not so definite, as it varies with the condition of the atmosphere, and with the altitude of the sun in the sky. The latter varies not only from hour to hour during the day, but also with the season of the year. Indeed, sunlight is so

variable that scientists have not been able to agree upon any specification for its use which would serve to give "sunlight" a definite value.

The specifications have been chosen so as to make the necessary tests as simple as possible. It has already been explained that the two principal purposes of optical specifications are to limit the visible and the ultra-violet light. The specifications nominally limit the ultra-violet which is transmitted to 1 per cent of that given out by the source. In reality, however, it does more than this and, indeed, it is desirable when intense sources of light like an electric arc are used to limit the ultra-violet to less than 1 per cent. The wave length of 406 millimicrons represents a bright line in the spectrum of light from a mercury-vapor lamp. This lamp is suitable for measurements of transmission at independent wave lengths, although, as pointed out above, it is unsuitable for measurements of total transmission. This source is especially rich in ultra-violet light and is useful on that account of carrying out a test of transmission for the ultra-violet.

Light having the wave length stated is visible to the eye, and consequently a measurement at this wave length can be carried out with the more usual optical apparatus and the measurement at this wave length can be made with high accuracy.

For the shorter wave lengths, designated as the ultra-violet, photographic methods must be resorted to or else the measurement carried out by means of some such instrument as the thermopile already referred to. The latter, however, is not very accurate for the short wave lengths.

Experience shows that glasses have a transmission for the ultra-violet which changes with the wave-length. Either the transmission increases rapidly, as the wave length is shortened below 406 millimicrons, or else diminishes rapidly, as the wave length is shortened. In the latter case, if the transmission is under 1 per cent at the wave length of 406 millimicrons, the transmission for the shorter wave lengths will be practically negligible.

In case the transmission at the shorter wave lengths is higher, a rough measurement at one of the shorter wave lengths will show it to exceed 1 per cent and it will consequently fail to comply with the specification.

It has not been attempted to limit the transmission of visible light to the definite amounts which will be proper in different processes and occupations, since the wearer of the goggles can decide very easily what is suitable for a particular purpose. No visible light which is comfortable to the observer will injure the eye. Consequently only rough and rather high limits have been set for the transmission of visible light.

To protect from glare the light must be cut down at least one-half. But still lower transmission will frequently be desirable.

For processes included in group H, such as oxy-acetylene welding and electric-resistance welding, no specific limit to the visible

has been set, but the total radiant energy has been limited to 50 per cent. This insures considerable reduction in the visible as well as in the infra-red. The processes included in this group will require among themselves quite different reduction in the intensity of the visible light. The reduction must be much greater in acetylene welding than in much furnace work and any figures which might be set as suitable for one would not be suitable for the other. The comfort of the wearer is a sufficient criterion for this purpose.

Electric-resistance welding differs very much in the conditions presented in different cases. Where the incandescent metal is almost entirely screened from the worker's eye by the aparatus or by the material itself, protection is optional with the worker. Where the intensely hot metal is exposed, the conditions are much the same as for furance work and similar protection is prescribed. The intensity of light differs greatly in different cases and a general prescription for the transmission of visible light would not be satisfactory. This is left for determination in individual cases, and comfort to the worker's eye is a good criterion of the sufficiency of the protective glass in this respect.

For electric-arc welding a lower maximum for the total energy has been set, since the source of light in this work is much more intense. An upper limit has also been set for the visible light, although it may be questionable whether this has any great value. In practice a glass will usually be required which reduces the intensity considerably more than the limit set in the specification. In attaining this purpose it is not necessary that a single glass be used.

A Small but Important Factor in Successful Welding

J. R. LESLIE†

Since a large part of a finished weld made by any of the modern processes of fusion welding represents added metal or metal from the welding rod, the nature of this added metal and the degree to which it merges with the parts to be joined, decide in large measure the success or failure of the weld. Just how much difference the rod itself makes in the speed of welding, strength and uniformity of results is interesting to note.

On a gas-welded steel pipe line recently completed in Southern California, it was found that a slightly lower grade of rod slowed down the progress of the welders by nearly 20 per cent. This represented a totally disproportionate increase in cost. As to reliability of the completed joints, 600 lb. hydrostatic pressure failed to produce a single leak in any of the joints made with the better quality rod.

†Technical Publicity Dept., Linde Air Products Co.

ing and electric-resistance welding, no specific limit to the visible

If all welding rods were alike, there would be neither danger from the use of inferior or unsuitable material, nor the opportunity for users to profit through recognition of the differences which do exist. To illustrate: if two pieces of cast iron are welded by the oxy-acetylene process with a rod cut from one of the pieces, the resulting weld will lack the strength obtainable with rod designed especially for the purpose. When melted cast iron suffers oxidation and loses some portion of its original constituents. In

Fig. 1. Good rod speeds up welding

its final form cast iron weld metal has a composition quite different from that of the rod. Hence the necessity for rods designed to give the right metal *in the weld*. Careful study of the changes taking place during fusion forms the working basis for the production of high grade rod. During manufacture the proper quantity of the more volatile elements is added to compensate for the changes that accompany the welding operation.

The bulk of modern oxy-acetylene welding is done with five types of rod; namely, drawn or Norway iron, "high test" steel rod, cast iron, bronze and aluminum. The first of these (preferably copper coated to prevent rust), is used extensively for welding such materials as mild steel castings structural steel, steel plate and wrought iron and steel pipe—to mention but a few of its applications. Where still greater strength is desired, high test rod is meeting with great favor, since it works easily and produces joints with tensile strength a full 20 per cent higher than those obtainable with drawn iron rod.

Cast iron welding rod finds its chief application to gray iron castings, from small tools to large machine parts of every description. Where the problems of expansion and contraction become serious and preheating difficult, welding with bronze rod is proving exceptionally satisfactory. Lower welding temperatures and the soundness of the welds produced make the use of bronze particularly desirable for a rapidly increasing variety of work.

Good rod, of no matter what metal, should work smoothly under the flame, without much variation or noticeable sparking. Rods produced by well-known and unquestionably reliable equipment manufacturers cost a little more than those of uncertain origin. The difference represents insurance whose cost is ridiculously small in comparison with the value of the completed job.

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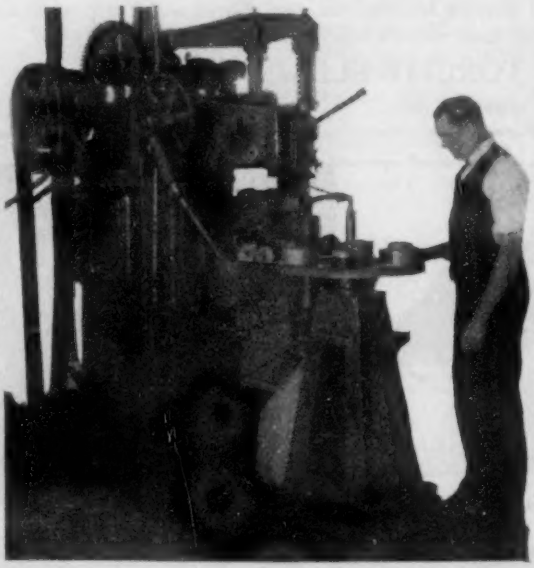
In the making of stabilators six welds are made to join the cover and drum. It is obvious that a considerable saving in time and cost would be made if all these welds were made simultaneously by the projection method in which a number of welds are made at each closing of the electrodes. In this method small points or projections are formed of a uniform size on a punch press on the surface of one part where the welds are to be.



Parts production increased to 16 pieces per minute by adoption of *ELKONITE* dies on Thompson 75-PA heavy-duty welder.

For this development a standard Thompson 75PA single spot welder was utilized, and the lower electrode was replaced by a table upon which 6 dies were mounted and which, actuated by a Geneva movement, rotates a sixth of a revolution at the end of each welding cycle.

Dies of various grades of copper were tried and proved to be the weak link in the development on account of being too soft, because after a few welds the projections on the material made impressions in the dies which increased rapidly in size and spread the current away from the weld, resulting in poor quality welds.

Elkonite, the new electrode material, finally gave the satisfactory results; this, on account of the fact that it is a combination of tungsten and copper, having a Brinnel hardness of 225 as compared with 82 for hard copper, and a compressive strength of 208,000 lbs. per sq. in., while that of hard copper is only 58,000 lbs. It is these inherent qualities of *Elkonite* which made the Watson experiment successful and increased production possible.

Heretofore copper dies produced but 50 completed pieces, *Elkonite* however produces 5000 and more before resurfacing becomes necessary, and *Elkonite* can be resurfaced at least 3 times.

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Left: Operator at work on one of the 16-inch steam risers. *Center:* Main riser with five manifolds, showing 8-inch welded connections. *Below:* 16-inch flange, welded on both sides of expansion joint.

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BEFORE Smith & Oby, Cleveland, plumbing and heating contractors and engineers, started to weld the steam risers that feed fifteen stories of the Ohio Bell Telephone Building, in Cleveland, they made test after test in the laboratory to find the welding wire they could depend upon to *hold*. Pieces of 8" pipe were butt-welded, test coupons were cut, and then pulled and bent—the coupons were all machined flush, and welded with the same machine and by the same operator. *In these tests the welds made with Wilson "Color-tipt" Welding Wire were the only ones that broke outside the weld.*

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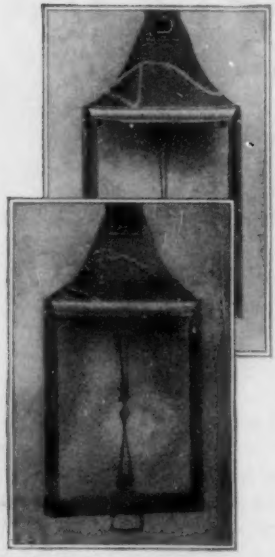

Broken cast iron scale platform welded with Tobin Bronze without pre-heating

THE danger of cracking and warping prohibited the use of methods involving pre-heating for the welding of this unsupported cast iron scale platform. By using Tobin Bronze Welding Rods, it was possible to make the repair without pre-heating in a furnace. The low welding temperature required for Tobin Bronze Welding also eliminated the danger of further cracking and reduced the risk of distortion and shrinkage.

Since Tobin Bronze has a tensile strength twice that of cast iron, welds correctly made with this material will not break at the joint. Tobin Bronze permeates the iron and forms a permanent bond stronger than the casting.

Many manufacturers who have proved the value of Tobin Bronze Welding for repair work are now using it to save time and money in manufacturing operations.

Tobin Bronze Welding Rods are made solely by The American Brass Company and each rod has the Tobin Bronze trademark rolled in the metal. They may be obtained from leading distributors of welding equipment and supplies.

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Welding leads may be disconnected or reversed without touching or exposing any current carrying parts.
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Exceptionally compact design—all controls at one point.
Plug and receptacle especially designed for quickly disconnecting both welding leads and also for reversing polarity, which is self indicating.
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Low center of gravity and short turning radius of portable machines.
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Generator, truck and base designed and built for arc welding requirements.
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Use of flexible coupling gives independent alignment and balance to both generator and motor. This coupling also permits the use of a standard motor which is easily interchangeable.

Welding Characteristics

The welding characteristics of the Hollup Arc Welder are best described by the word "work-wise"—the product of the combined ideas of several of the foremost welding engineers in the United States. The maximum amount of metal can be deposited efficiently for any given class of work, with the least amount of effort on the part of the operator.

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Your neighbor
the petroleum refiner
adopts the oxy-acetylene process*

IN 1913 about 11% of the crude oil was recovered as gasoline. Today the gasoline yield is about 37%. Back of this amazing development are a number of factors and one of the most essential of these is oxwelding.

Every engineer who has had a hand in this work will tell you that without oxwelding the present refinery equipment could not have been made.

Instead of the old shell type still, from which the oil was vaporized by direct firing into a condenser coil immersed in a tank of water, the present trend is toward continuous pipe stills and fractionating columns operated under pressure. Such equipment is vastly more complicated in design and could not be made (we speak advisedly) if it were not for oxy-acetylene welding and cutting.

The rapidity with which complicated manifolds, interchangers, fractionating towers and supporting structures can be fabricated with oxwelding has enabled the engineers to test out a variety of equipment design. The leakproof joints of oxwelded equipment make it possible to put a plant in operation quickly without interminably caulking joints. And when repairs or a change in design is desirable, the welding and cutting blowpipes are ready to do the job.

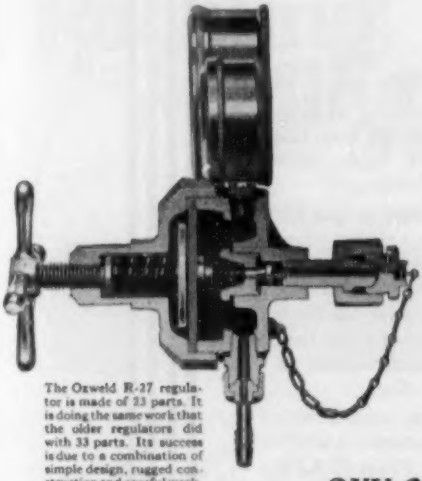
Imagine, for example, trying to operate a whole still piping and condenser system at a pressure just a few millimeters above absolute, without welded joints.

Every engineer in every industry must in self-defense become thoroughly familiar with the oxy-acetylene process. And Linde has at hand detailed information on hundreds of applications of the oxy-acetylene process. Our engineers stand ready to advise you about its use in your business.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
General Offices: Carbide and Carbon Building
30 East 42d Street, New York
37 PLANTS . . . . . 107 WAREHOUSES

LINDE OXYGEN

* No. 7 of a series of advertisements on the engineering phases of oxy-acetylene welding and cutting. Send for the booklet entitled "Engineering and Management Phases of Oxwelded Construction."



The Oxweld R-27 regulator is made of 23 parts. It is doing the same work that the older regulators did with 33 parts. Its success is due to a combination of simple design, rugged construction and careful workmanship. It is not a nozzle type regulator. It has exceptional flow capacity for this reason and will work without freezing. Several years of service in both high and low temperatures have shown it to be simple, sturdy and reliably accurate.

"Continuous" oxy-acetylene regulation

THE AVERAGE MECHANIC can take the Oxweld R-27 regulator to pieces, put in new parts and completely reassemble it in a few minutes.

This sounds like a trick stunt, but it isn't. It illustrates dramatically the simplicity of design of these gas regulators for oxy-acetylene welding and cutting.

Just think it over. After a certain period of service the regulator seat needs to be replaced. That's what happens in any regulator. It usually happens at a time when it is most inconvenient. Yet with the R-27 regulator you can have a reconditioned unit in a few minutes, at a cost of a few cents. In fact, the whole "inside works" costs only $3.60.

Unless you like to have your mechanics spending time on tools instead of productive work, Oxweld R-27 regulators are an economy that you can not overlook.

The R-27 regulator is a typical piece of Oxweld equipment. Oxweld customers need no other recommendation.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC

CHICAGO 1642 Jasper Pl. | LONG ISLAND CITY, N. Y. Thompson Ave. and Orton St. | SAN FRANCISCO 1056 Mission St.

STOCKS IN 30 CITIES

Oxweld
WELDING AND CUTTING APPARATUS

Oxweld it!

It wasn't so very long ago that a broken casting frequently meant sizable financial loss: idle machines; expensive new parts; delay until they could be received and installed.

Nowadays the repair of castings is quickly accomplished with oxy-acetylene welding, often without dismantling the machine. Most master mechanics are thoroughly familiar with the process and know that the technique has been perfected. The simplicity of repairing a machine on the spot without any delay has saved many companies thousands of dollars.

Most of these repairs are made with Prest-O-Lite dissolved acetylene—the standard welding gas for 22 years. Because of Prest-O-Lite, welding progress has been possible.

Prest-O-Lite
DISSOLVED ACETYLENE

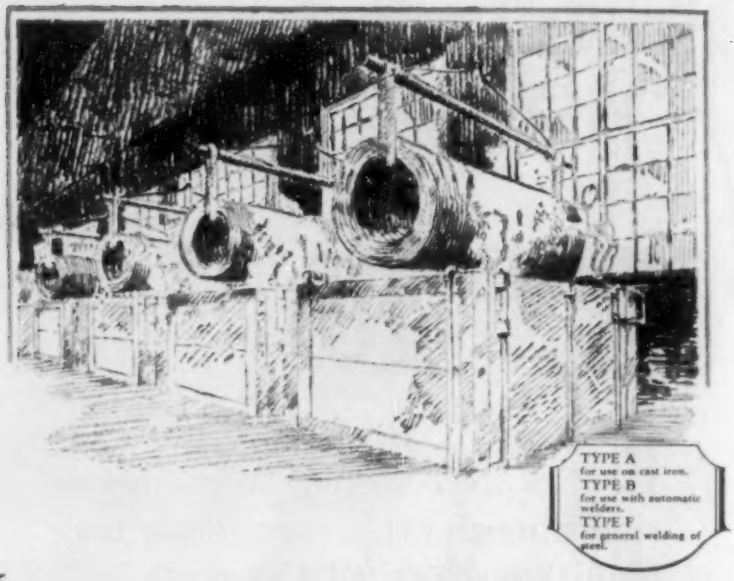
22 years old and still growing

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York
31 Plants—88 Warehouses

Roebling Welding Wire

ROEBLING Welding Wire makes strong, tough welds, is positively uniform throughout all shipments and conforms to all standard specifications.

John A. Roebling's Sons Company
Trenton, New Jersey



Here is where you save money

In absolute reliability of operation and over-all efficiency, G-E arc-welders are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

In these vats an exclusive G-E treatment helps to stabilize the arc of Type F, G-E Welding Electrode. The sputtering, dissipating elements of the electrode are reduced to an absolute minimum.

By preventing dissipation, concentration of the arc is increased.

With a concentrated arc, better fusion is obtained.

Smooth, clean and strong welds are what you are after and Type F Electrode brings this result economically—surely.

One of our special Welding Electrode Distributors will be glad to give you a complete explanation of the three G-E Types.

Special Distributors for G-E Welding Electrodes

American Steel Eng. Co.,
10 South 18th St.,
Philadelphia, Pa. also
601 Granite Bldg., Pittsburg, Pa.

Bird-Potts Co.,
Atlanta, Ga.

Capital Electric Co.,
Salt Lake City, Utah.

Robert M. Hartwell,
353 East 2nd St., Los Angeles, Cal.

Hendrie & Bolthoff Mfg. & Supply Co.,
Denver, Colo.

Industrial Sup. Co., Inc.,
329 East Second St.,
Los Angeles, Cal.

Matthews Electric Sup. Co.,
1823 First Ave.,
Birmingham, Ala.

P. P. McDonald & Co.,
17 King Terminal,
Boston, 27, Mass.

National Welding Equip. Co.,
323 Main Street,
San Francisco, Cal.

W. A. Ramsey, Ltd.,
74 Queen St.,
Honolulu, Hawaii.

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Buffalo, N. Y.

Joseph T. Ryerson & Son, Inc.,
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Southwest General Elec. Co.,
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Strong, Carlisle & Hammond Co.,
Cleveland, Ohio.

Union Iron Works,
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Oliver H. Van Horn Co., Inc.,
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Virginian Electric Inc.,
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Welding Service Co.,
50 Church Street,
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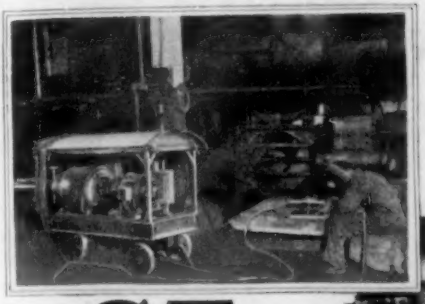
A. J. Wilson Co., Inc.,
130 Liberty St.,
New York, N. Y.

550-16D

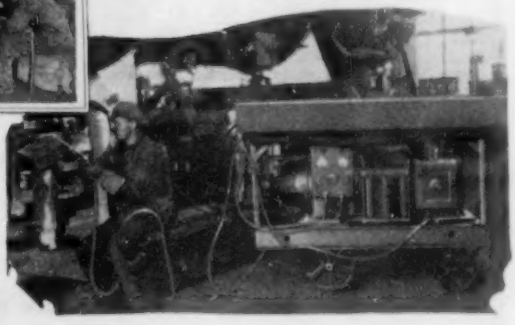
GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT



Building up a worn cross-head with a G-E Portable Arc Welder in the roundhouse of the Fort Worth and Denver City R. R. Co.

Building up worn spots on a locomotive frame with a G-E Portable Arc Welder at Bellmead (East Waco) Shops of Missouri-Kansas-Texas R.R.



G-E Arc Welders *are Modern Menders of Locomotives*

Turn over your locomotive ailments to G-E Arc Welders. Cracked fire boxes, broken frames, broken wheel-spokes, damaged cross-heads, worn stoker conveyors, flat spots on wheels—and innumerable other damaged parts—can be made new by G-E Arc Welders with remarkable savings in cost.

Arc welding produces a superior weld—a more ductile, homogeneous, stronger weld.

Arc welding is faster—the heat of the arc is concentrated at the weld.

Arc welding is more economical—electricity generates intense, confined heat at the minimum cost.

Arc welding is simpler—less preparation, less finishing, easier to apply in difficult locations.

G-E Arc Welders are typically G-E in quality, meet A.I.E.E. standards, are conservatively rated, and will give you years of welding satisfaction. Further information as to the application of arc welding to locomotives will gladly be given to you. Phone or write your nearest G-E office.

General Electric furnishes to the Welding Industry:

- WD Arc Welders—designed for one operator
- Constant Potential Sets—for several operators
- Arc Welding Resistors—for mining and traction companies
- Automatic Sets—for repetition work

Complete information and bulletins available at your nearest G-E office.

530-24D

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

BOUND VOLUMES JOURNAL NOW READY

A number of Bound Volumes of the Journal for 1926 have been bound in attractive book form. Members may obtain copies at $5.00, non-members $10.00.

ACETYLENE IN PORTABLE CYLINDERS FOR OXY-ACETYLENE WELDING AND CUTTING

Do you understand our free loan cylinder plan? If not, we are glad to explain

Supplied in the following size cylinders:

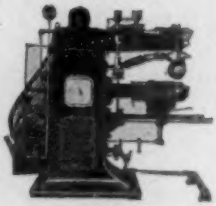
10" x 30"—capacity 125 cu. ft.
12" x 36"— " 225 " "
12" x 44"— " 275 " "

Prompt and efficient service on any quantity through plants and warehouses and truck deliveries.

Commercial Acetylene Supply Co., Inc.
(Main Office) 71 Broadway, New York City, N. Y.

BRANCHES:
613 Trust Co. of Georgia Bldg., Atlanta, Ga.
80 E. Jackson Boulevard, Chicago, Ill.
553 Monadnock Bldg., San Francisco, Cal.

SPOT



SEAM

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OUR EXHIBIT
NATIONAL STEEL &
MACHINE TOOL EXPOSITION
DETROIT
CONVENTION HALL
Sept 19-25
BOOTH
150

ARC

For Production
Electric Welding
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Gibb Welding Machines Company

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House Lighting
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Oxyacetylene
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In the
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Saves You Money

NATIONAL CARBIDE SALES CORPORATION, 342 Madison Ave., N.Y.

THERMIT

1902 — Twenty-five Years — 1927

Our engineering organization starting with a scientifically correct principal twenty-five years ago has developed the Thermit process to its present highly efficient state.

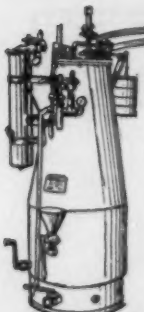
Today it is inexpensive, proven, practical and simple in its application to all classes of work involving the repair of medium and heavy size sections of iron and steel.

WELDING

Metal & Thermit Corporation

120 Broadway, New York

Pittsburgh Chicago Boston S. San Francisco Toronto



Why Experiment?

Torches
Regulators
Generators
Compressors
Manifolds
Preheaters
Paint Sprays
Carbide Lights

Catalog 54?

SINCE the infancy of the industry, expert engineers and skilled workmen have maintained the predominance of Milburn Equipment.

Its acceptance as standard equipment by large industrials, railroads and Government Departments the world over exemplifies Milburn leadership.

THE ALEXANDER MILBURN CO.
Baltimore, Md.

When you install UNA Rail Joints, you eliminate the gap between the rail ends without in any way changing the original steel structure of the running surface of the rail at the joint.

UNA WELDING AND BONDING COMPANY
CLEVELAND, OHIO

Welding Processes
Welding Rods

UNA

A.C.-D.C. Welders
Welding Supplies

How to get *better* welds at *less* cost—

Welding wire and electrodes are an important factor in securing better welds at less cost. They must be right—always right—if lost time and ruined work are to be avoided.

That's why Page Welding Wire helps you cut costs. Every piece is carefully processed to insure uniform welding qualities. What is more, every run is *shop tested*. You know it has the qualities essential for best production under *job* conditions.

Another thing, every piece is stamped with a grade name. There is no guesswork about its use.

You can prove for yourself the superiority and economy of Page Wire. Samples for tests in your own shop will be sent on request. Just tell us where to ship them.

PAGE STEEL AND WIRE COMPANY

An Associate Company of the American Chain Co., Inc.

Bridgeport, Connecticut

District Sales Offices: Chicago New York Pittsburgh San Francisco

PAGE-ARMCO PROCESSED

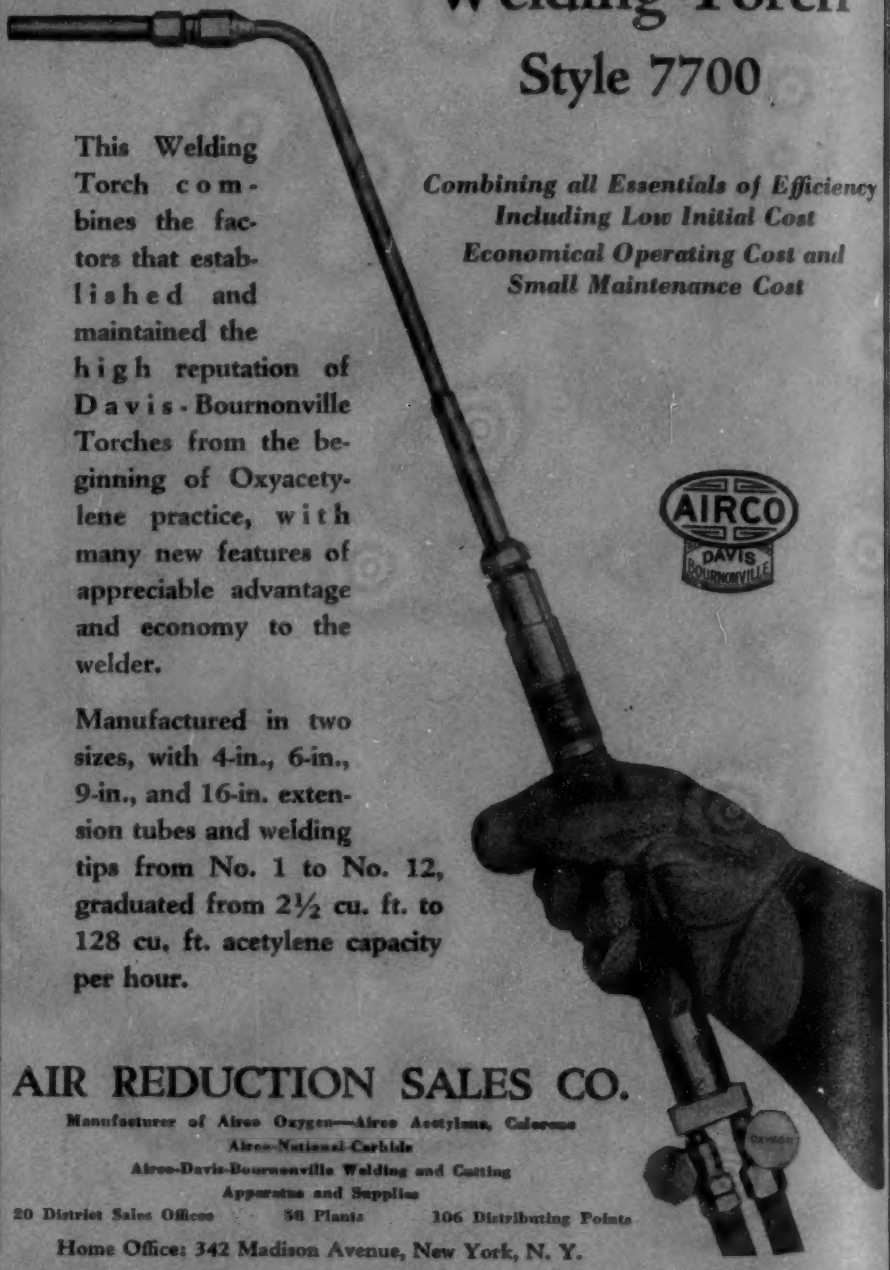
Welding Wire *and* Electrodes

An Airco-Davis-Bournonville

Welding Torch

Style 7700

Combining all Essentials of Efficiency
Including Low Initial Cost
Economical Operating Cost and
Small Maintenance Cost



This Welding Torch combines the factors that established and maintained the high reputation of Davis-Bournonville Torches from the beginning of Oxyacetylene practice, with many new features of appreciable advantage and economy to the welder.

Manufactured in two sizes, with 4-in., 6-in., 9-in., and 16-in. extension tubes and welding tips from No. 1 to No. 12, graduated from 2½ cu. ft. to 128 cu. ft. acetylene capacity per hour.

AIR REDUCTION SALES CO.

Manufacturer of Airco Oxygen—Airco Acetylene, Calcerene
Airco-National-Carbide
Airco-Davis-Bournonville Welding and Cutting
Apparatus and Supplies

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